MANAGEMENT OF TECHNOLOGY TRANSFER AND ABSORPTION

MBA [Production and Operations Management]

Paper 4.1



ALAGAPPA UNIVERSITY

Karaikudi - 630 003 Tamil Nadu, India

Reviewers	
Dr. S. Kaliyamoorthy	Professor and Director, Alagappa Institute of Management, Alagappa University, Karaikudi
Dr. K. Chandrasekar	Assistant Professor, Alagappa Institute of Management, Alagappa University, Karaikudi

Author: Dr Jaspreet Kaur, Associate Professor Trinity Institute of Management (GGSIPU)

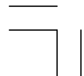
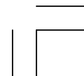
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SYLLABI-BOOK MAPPING TABLE

Management of Technology Transfer and Absorption

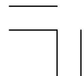
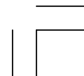
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INTRODUCTION

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Technology transfer is the process of transferring technology from the places and in groups of its origination to wider distribution among more people and places. It occurs along diverse axes: from large businesses to smaller ones, from governments to businesses, both formally and informally, and both openly and surreptitiously. On the other hand, technology transfer means the acquisition, development, assimilation and utilization of technological knowledge and capability by a company from an external agency. It occurs between transferring and receiving entities.

Both these processes are vital for companies. Depending on the type of technology transfer and absorption, they help advance knowledge in a particular field or further develop a technology. They also allow companies to develop a niche in a particular field or may even help lower costs of production.

This book, *Management of Technology Transfer and Absorption*, contains six units. It follows the self-instruction mode wherein each unit begins with an Introduction to the topic of the unit followed by an outline of the Unit Objectives. The detailed content is then presented in a simple and structured format interspersed with Check Your Progress questions to test the student's understanding. A detailed Summary and a set of Questions and Exercises are also provided at the end of each unit for effective recapitulation.

UNIT 1 TECHNOLOGY TRANSFER AND ACQUISITION

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Structure

1.0 INTRODUCTION

In this age of immense competition, it has become imperative for companies to not only create but also absorb new technology so as to maintain a competitive edge. Businesses, such as those involved in extracting or commercializing raw materials-that run in sectors where prices determine competition- may go for new machinery or equipment to improve their efficiency and productive processes. They may adopt the latest technologies to make their management structure better and establish better control and communication.

However, in other sectors, where new products with advanced features keep entering the market frequently, companies have no option but to innovate, for which they acquire new technologies.

In this unit, you will learn the meaning of technology transfer, its process and why it is required. You will also become familiar with the techniques of technology transfer and its relation with intellectual property rights, among other things

1.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Define transfer of technology
- List the various ways of transferring technology
- Explain the process of transfer of technology within and between nations
- Understand IPR protection regimes and technology transfer
- Discuss the enforcement of intellectual property rights in India
- Outline the role of the host or source country's trade and investment policies in the process of technology transfer

1.2 TECHNOLOGY TRANSFER: MEANING, NEED AND PROCESS

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Transfer of Technology: It refers to the movement of innovations, knowledge, and techniques from one organization or country to another through assistance, investment, licensing, trade, or training.

The process by which technology is disseminated is called 'technology transfer'. This is a process of transfer of knowledge by the transferor to the recipient". This may or may not be legally binding.

Technology transfer, which is also known as transfer of technology (TOT), is the process of transferring technology from the place of its origination to the wider distribution among larger groups of people and places.

Technology travels through many channels and universities, to businesses. It then moves from large businesses to smaller ones, from governments to businesses, across borders and so on. Technology transfer occurs generally due to the need to share skills, technologies, knowledge, manufacturing methods, facilities among governments, universities and other institutions. The aim is to ensure that scientific and technological developments become accessible to a wider and larger group of users, who can then further develop and exploit the technology to generate new products, processes, applications, materials, or services.

Technology transfer is also related to knowledge transfer. The horizontal transfer of technology is the movement of technologies from one area to another. Generally, the transfer of technology is primarily horizontal, but it can also be vertical. When technologies move from the applied research centres to the research and development departments, it is called vertical transfer.

1.2.1 Process of Technology Transfer

The process of technology transfer has to be understood in detail. Universities and governmental organizations have technology transfer offices, which identify and research areas with potential commercial interest and strategies that can be exploited. The research result could be of scientific and commercial interest, but the patents are generally issued only for practical processes. Therefore, the researchers should come up with a specific practical process. One of the major considerations is 'commercial value' in the process of technology transfer. For example, there are many ways to accomplish nuclear fusion, but the crucial ones are those which have a commercial value attached to them and can generate more energy.

The process to commercially exploit the research varies. Commercial exploitation could include licensing agreements or a set and setting of joint ventures to share the risks and rewards for introducing new technologies to the market. When an organization does not have the resources to develop a new technology, one could use the spin-outs. These approaches are related to raising venture capital (VC), which becomes a means of funding the development process, a common practice in the United States. In comparison, the European Union has a conservative approach to venture capital funding. Research companies become a vehicle of commercialization as is seen in most parts of Canada, in which the rate of licensing of Canadian university research is far below that of the US.

Technology transfer offices can work on behalf of research institutions, governments or large multinationals. The main clients of the companies working on

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technology transfers are the start-ups and spin-outs that pay a commercial fee, which can be waived in case there is an equity stake in the business. It is because of the potential complexity of the technology transfer process that the technology transfer organizations are generally multidisciplinary, and include the economists, engineers, lawyers, marketers and scientists. It is the dynamics of the technology transfer process, which has attracted attention for the topic from dedicated societies and journals.

Technology could be transferred through a license agreement, where the university or the researcher owns the intellectual property, and the industrial partner obtains conditional rights for using and developing the technology. Before the final technology transfer, the inventors must define the nature of their invention to the institution's technology transfer office. The new inventions are evaluated by the technology licensing experts. They then determine the intellectual property position and potential market for the given technology.

The technology transfer office cannot proceed with the invention till the intellectual property is available. Inventions with an appropriate intellectual property and market position are generally taken forward. The invention management and commercialization strategy will start after the intellectual property rights are established.

Technology transfer needs a proactive approach which combines the engaging researchers, technology, and industrial partners to use the technology.

The goal of the commercialization strategy is to form a commercial relationship with another party (which could be sale or license), and negotiating a contract (which could be compensation). A license is a contract between a licensor, who could be the holder of a patent, and a licensee who could be an industry partner. This contract has a number of conditions which the third party has to satisfy. The licensee could be an established company or a new business start-up.

The technology transfer office can grant a nonexclusive, partially exclusive, or exclusive license. The multiple nonexclusive licenses could be granted to many companies to offer better opportunities, which can broaden the use of an invention in different fields. The industry partner has to satisfy a number of conditions that include creating a satisfactory development and marketing plan, information about the ability of the company to implement the plan, develop it and commercialize the invention in a specified period of time, after making financial payments to the university or researcher. These payments could be distributed to the inventors and can be shared within the institution so that they can support the additional research and technology transfer activities.

1.2.2 Transfer Within and Between Nations

There are many methods of technology transfer among nations. Each method of technology transfer depends on the technology analysis, investment resources, the strategy of cooperation with the company's supplier, and technical capacities of the company. While choosing the technology transfer method, the company has to understand that the more complex the technology, the closer will be the connections between the buyer and the supplier. Traditionally, the technology transfer used to end with the delivery of the equipment. This equipment itself does not generate new competences. The main challenge is when the company's work changes after the

technology transfer. This includes the transfer of knowledge, skills, and intellectual property rights in the process of technology transfer.

The main technology transfer methods are as follows:

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(a) Licensing

Licensing is an agreement wherein the owner of a trademark, patent, or other intellectual property gives permission to a party or a company to use the technology, developed by him (her), in a certain area, for a specific period of time.

The main types of licenses are:

(i) One that grants an exclusive right to use the technology.

(ii) One with non-exclusive right, in which the patent owner will transfer the right of using the technology to other companies in the same area.

The licensing agreement may also include a sublicensing clause, which allows the licensee to grant the right to use the technology to someone else.

There is one major advantage of buying a license patent, which is that it has lower costs, in comparison to other technology-transfer methods. The purchase of a license requires sufficient knowledge, experience, relevant expertise and manufacturing base for the in-house technology implementation.

(b) Support Contract

As per this agreement, the technology owner participates in the technology implementation, providing personal training and technical assistance at each stage of the technology transfer.

This involvement of the technology developer brings in a closer cooperation among the two parties that helps in the complete transfer of knowledge and skills related to the technology. Thus, the support contract could be a part of the licensing agreement, to enhance the transfer efficiency.

(c) Joint Venture

Another method of technology transfer among nations is the joint venture. This is an agreement between two or more companies to execute a particular business. The joint venture includes the involvement of mutual assets, risks, management, profit sharing, co-production, services and marketing.

The joint venture is beneficial as there is a long-term cooperation between the parties, there is a motivation among all participants in the technology transfer, and the cost of working is reduced in the JV.

There are some disadvantages of the joint venture, which are the different vision and goals of the partners, and the lack of independence in management. The companies may also not be able to establish objectively in the value of capital, which has been contributed by each of them. Therefore, the evaluation of profits distribution also becomes difficult. The foreign company could provide innovative technology and management competence, and the local partner could provide a known marketplace and market regulation. Each asset has to be of value.

(d) Franchising

Franchising is said to be an agreement where one company grants the right to use its trademark or business model to the other party. The buyer of the franchise starts with the manufacturing and selling of goods as per the seller's specification. The company, which owns a trademark, shares its experience in operating the franchised product or technology.

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One of the benefits of franchising is that the company gets a well-established brand. With the franchised product, the company also gets the well-built business model, and knowledge in the product's management and marketing.

The disadvantages of the same are that the company becomes dependent on the technology owner. In many cases, the company has to purchase equipment, raw materials, and other products from specific vendors. The company also has to follow internal rules and procedures which pertain to the technology owner. Thus, the company might not be able to bring the product to other markets or sell the franchise. Also, the decline of the franchise owner's reputation might impact the company which has bought its franchise.

(e) Strategic alliance

A strategic alliance agreement happens between two or more big companies so as to be able to use the specific skills of each of them for the development of new innovative technologies. Strategic alliance could be in the form of research programmes, joint laboratories, production and promotion of the new product.

The mutual efforts of the different partners could give better results as compared to the independent development of a new technology. In the joint operations, both the companies can get the needed experience in new areas and also experience different types of management.

The major drawback of a strategic alliance is the complexity in managing companies, which have different cultures. Thus, the two teams of managers could differ in their approaches. The companies could also have different goals and strategies for the future of their organization; they may also differ in the business development plan for the new technology.

(f) Turnkey Agreement

The turnkey agreement, is an agreement wherein the general contractor is responsible for all the procedures in relation to the technology transfer, technology design, equipment supply, financing, construction and commissioning.



Turnkey Agreement: It is an agreement wherein the general contractor is responsible for all the procedures in relation to the technology transfer, technology design, equipment supply, financing, construction and commissioning.

The benefit of the turnkey agreement is that the company concludes a contract wherein one supplier takes full responsibility for the project execution. Also, the project will carry a fixed price, and the supplier guarantees the performance of the technology.

The disadvantage of this type of technology transfer is that the company should know in advance the features and output parameters that the technology should have after the launch. Also, a complex technology might need a deep knowledge of the corresponding field. Therefore, one may need an independent expert organization to determine the technology's output characteristics. The transfer price in the turnkey

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agreement could be much higher as compared to the other methods of technology transfer. This is because, the more risks the supplier takes, the higher the price would be during the transfer implementation. In this type of technology transfer, the company may not have full control on the progress and quality of the stages of transfer. The contractor's financial problems could also lead to the project suspension. It is difficult to determine the supplier's financial capacity at all stages of the transfer.

The risks of the turnkey agreement could be reduced by involving the supplier in the capital of the new entity. This could motivate the supplier to enhance the quality of the new technology, and will also be able to use the supplier's experience in the future operational processes.

(g) Equipment Acquisition

Equipment Acquisition is a simple technology acquisition and, therefore, one of the most common methods of technology transfer. One of the disadvantages of this method is that the company limits itself to only the technical knowledge, which is incorporated through the equipment, and will not gain any new competences in management or production. Also, the equipment available in the market will not give any unique privilege to the buyer, as the equipment may be purchased by any competitor.

(h) Management contract

Technology can also be transferred through a competent expert, who could be 'enticed' from another company. This method involves minimum costs. The same is effective only for small projects, which use very simple technology. Also, the technology should not be patented.

(i) Foreign company acquisition

A company could acquire a foreign start-up, which is developing a new technology. The company will get the technology, and a capable team to develop the technology in the future. The acquisition of a foreign firm will also place the company on the new international market.

One of the main issues in this type of transfer of technology is the possibility of the resignation of key employees after the acquisition. Also, the founders of the successful start-up will only sell to the company at a price, which is significantly higher than the market. This might risk the profitability of the company in the future.

(j) Foreign Direct Investments

Foreign direct investment is one of the methods of technology transfer at the state level. In this type of technology transfer, the foreign company invests in developing countries to create a new market, and remove export barriers to get an access to the cheap labour and cheap resources of the country.

In this type of technology transfer, a developing country will enjoy the benefits of technology transfer, especially in terms of progress in its research environment. This could also create new jobs for the developing countries.

For this type of technology transfer, the developing country government, has to make some concessions for the FDI policy. Without these concessions, the large

international corporations will not be motivated to make long-term investments in developing countries.

(k) Buy-back contract

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A buy-back contract is a form of agreement between developing countries and large foreign companies. In this agreement, the foreign company supplies industrial equipment to the developing country in exchange for profits derived from the sale of raw materials or goods produced on this equipment. This kind of technology transfer could be used in the construction of new plants for developing countries. Here, the state becomes a shareholder in the created enterprise.

This is beneficial for the developing country, which gets high-tech equipment without directly investing in it. The foreign company could be responsible for the performance of supplied technologies.

One of the disadvantages of this method of technology transfer is that the buy-back contract could be a motivation for the company to start production at minimum costs, which could affect the execution quality. In a buy-back agreement, the price for new technology is generally much higher as compared to the direct investments.

(l) Original equipment manufacturer (OEM)

Original equipment manufacturer or OEM is a form of subcontracting, in which the local firm starts manufacturing as per the foreign company's specifications. The foreign company transfers a part of its technologies and equipment. The company also conducts training and management reorganization. The foreign company sells produced goods with the help of the channels and under its trademark.

OEM agreement helps the local companies to obtain new technologies and to reorganize their production. With the help of the new equipment and skills, the local companies can produce new goods for the domestic market under their own brand. The disadvantage of this agreement is that the company is obliged to supply products to the foreign company at a fixed price. This price is much lower than the market price.

1.2.3 Essence of Technology Transfer

Technology transfer is important as it can develop early-stage intellectual property, which is useful for the research community, or the new platforms and products, which can be converted into products for public and commercial use. It is through technology transfers that successful collaborations can be formed between the researchers across different universities or industries. This can lead to the advancement of knowledge in a particular field, which can further develop a technology. These technology transfers could result in licensing and sponsored research opportunities, which could benefit both partners.

Technology transfer has to ensure that the interests and rights of the university or the researcher in the intellectual property have been protected. The university or researcher could retain the intellectual property rights of the technology and could issue a license for the conditional use of the technology.

The transfer of technology could help promote the research institution and bring benefit to commercial partners. The university or the R&D department of the company,

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which comes up with a new technology, gets recognition and increases its reputation for the innovation potential. Industry partners can reduce the costs, which have been incurred in the research & development stage by licensing technology. Another advantage for the R&D department of the company would be using the licensing revenue for further research and training of the institution. Companies can protect their investments in research by patenting new technologies. This gives them an opportunity to reach commercialization. The company's investments in the technology could stimulate local economic development. The beneficiary of the technology transfer is the public or consumers, who gain from the products that reach the market and the increase in jobs, which result from the development, manufacturing, and sale of products.

Thus, research commercialization is the biggest benefit of technology transfer. Technology transfer could also complement the academic research by enhancing innovations among the industry partners, who could develop the products from this technology for the benefit of the general public. In case a research discovery solves a significant problem, but the research is innovative and unpublished, then one could attach a commercial potential or research value to it through the technology transfer office.

1.3 IPR PROTECTION REGIMES AND TECHNOLOGY TRANSFER

Let us begin by examining the concept of intellectual property (IP).

Intellectual Property

Intellectual property or IP refers to the creation of the intellect for which a monopoly is assigned to designated owners by law. Intellectual property rights (IPRs) are said to be the rights, which are granted to the creators of IP. These could include trademarks, patents, copyright, industrial design rights, and sometimes, trade secrets. IP could refer to artistic works, which include music and literature, discoveries, inventions, symbols, words, phrases and designs, which can be protected as intellectual property.

The term intellectual property was coined in the 19th century but started being used in the 20th century, and is now very common when it comes to technology transfer and acquisition.

Intellectual property rights

Intellectual property rights or IPR can include patents, copyright, plant variety rights, trademarks, trade dress, geographical indications, industrial design rights, and sometimes trade secrets. There are some specialized varieties of sui generis exclusive rights, the circuit design rights (which are called mask work rights) and supplementary protection certificates, which pertain to pharmaceutical products (expiry of a patent) and database rights (European law).

Patents

A patent is a form of right granted by the government to the inventor, giving the owner the right to forbid others from making, selling, using, and importing an invention for a limited period of time. This is done in exchange for allowing the public disclosure of the

Check Your Progress

1. What is technology transfer?
2. Why does technology transfer happen?
3. What is the biggest advantage of technology transfer?

invention. The invention becomes a solution to the specific technological problem. This technological problem could be the product or a process and will have to fulfil three main requirements:

(i) It has to be new
(ii) It should not be obvious
(iii) It has to have an industrial applicability

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Copyright

A copyright gives exclusive rights to the creator of the original work generally for a limited time. Copyright could also be applied to the wide range of intellectual, creative, artistic forms, of works. Copyright will not only entail the ideas and information themselves, but will also entail the manner in which they are expressed.

Industrial design rights

An industrial design right, which is also referred to as the 'design right' or design patent is a right, which protects the visual design of objects that are not purely utilitarian. An industrial design entails the creation of a shape, composition of pattern, combination of pattern or the colour in three-dimensional form which contain some aesthetic value. An industrial design could be a two- or three-dimensional pattern which is used to produce a product, handicraft or an industrial commodity.

Plant varieties

Plant variety rights are said to be the rights to commercially use a new variety of a plant. The variety has to be novel and distinct as only then can it be registered for evaluation of propagating material.

Trademarks

A trademark is the recognizable sign, design, logo or expression which differentiates the products or services of a particular trader from similar products or services of other traders.

Trade dress

A trade dress is known to be a legal term of art that usually refers to characteristics of the visual or aesthetic appearance of a product or the design of a building or packaging of a product, which signifies the source of the product to the consumers.



Trade dress: It is a legal term that generally refers to characteristics of the visual appearance of a product or its packaging (or even the design of a building) that signify the source of the product to consumers.

Trade secrets

A trade secret is said to be a process, formula, practice, design, instrument, pattern, or information compilation, which is not known or cannot be ascertained, and the business can obtain an economic advantage over competitors for the same. There is no formal government protection granted for this; and each business has to take measures to protect its own trade secrets.

1.3.1 Objectives of Intellectual Property Law

Intellectual property laws are aimed at promoting progress. With the exchange of limited exclusive rights for the disclosure of inventions, the patentee/copyright owner

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gets the benefit, for creating and disclosing their work. The main objective of the intellectual property could also be that those who support its implementation find an 'absolute protection' in it. In case an intellectual property is desirable as it encourages innovation, then the same could be crucial in progression. The idea is that the creators should have sufficient incentive to invent and establish a social value of their inventions. This absolute protection treats intellectual property as any 'real' property, and adopts its law and rhetoric. Some of the recent developments in intellectual property law, the America Invents Act, focus on international harmonization. Intellectual property rights could also be used to protect cultural heritage, and avoid risks of commoditization, which can be derived from this possibility.

Financial incentive

The exclusive rights help the owners of intellectual property to get some benefit from the property they have created, and this gives some financial incentive for the creation of an investment, which is now categorized in the intellectual property. In case of patents, the researcher can earn an amount, which could pay for his associated research and development costs. The IP could also be used to promote the progress of science and useful arts, by giving the authors and inventors the exclusive right to their respective writings and discoveries for a given period of time.

In 2013 the United States Patent & Trademark Office stated that the worth of intellectual property to the U.S. economy is somewhere around US $5 trillion and could create an employment for about 18 million American people. In developed nations, the value of intellectual property is considered to be high especially in the European Union. In the UK, IP is seen as an asset class for the use of pension-led funding along with other types of business finance.

Economic growth

The World Intellectual Property Organization (WIPO) treaty and many such international agreements talk of the protection of intellectual property rights, which is crucial for maintaining economic growth. The WIPO Intellectual Property Handbook argues that intellectual property laws are needed for the following purposes:

(i) To give a statutory expression to the moral and economic rights of creators for their creations and give them the rights of the public for their creations.

(ii) To promote the IP as an act of government policy, for enhancing creativity and application of its results so as to encourage the fair trading, which could contribute to economic and social development.

The Anti-Counterfeiting Trade Agreement (ACTA) explains the effective enforcement of intellectual property rights, which is crucial for sustaining economic growth among industries and globally.

Economists estimate that two-thirds of the value of large businesses in the United States can be traced to intangible assets. IP-intensive industries could generate 72 per cent more value-added price minus material cost per employee than 'non-IP-intensive industries'.

Some research projects, such as the one with WIPO and the United Nations University have been measuring the impact of IP systems on six Asian countries. They found positive correlation between the strengthening of IP systems and economic growth.

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Morality

As per Article 27 of the Universal Declaration of Human Rights, everyone has the right to the protection of the moral and material interests which result from the scientific, artistic, literary production of the author. The relationship between intellectual property and human rights can be complex. There are many moral arguments for intellectual property.

Intellectual property can be justified morally. Personality theorists feel that intellectual property is an extension of the individual. Utilitarians also feel intellectual property is a precursor to the social progress and could motivate the people for further innovation. While those who follow John Locke's philosophy explain that the intellectual property is justified on the basis of the deservedness and hard work of the author or researcher.

Some moral justifications for the private property could be used to argue in favour of the morality of intellectual property.

Infringement, misappropriation, and enforcement in case of IP

Any violation of intellectual property rights, which is called 'infringement' when it comes to copyright, patents, and trademarks, and 'misappropriation' for the trade secrets, could be a breach of civil law, based on the type of intellectual property, which is involved under the jurisdiction, as per the nature of the action.

In 2011, the trade in counterfeit copyrighted and trademarked works was estimated to be a $600 billion industry worldwide, and thus accounted for 5-7 per cent of global trade.

Patent infringement

Patent infringement is generally caused by the use of or sale of a patented invention without permission from the patent holder. The patented invention or the level of protection is defined in the claims of the granted patent. One can see a safe harbour in some jurisdictions, which have been used as a patented invention for research. This provision exists in the US when the research is done for philosophical purposes or is done in order to prepare an application for the regulatory approval of a drug. Thus, the patent infringement cases could be handled under civil law, but several jurisdictions could lead to infringement in criminal law.

Copyright infringement

Copyright infringement could be said to be reproducing, displaying, distributing, performing a work, or making derivative works, without the permission of the copyright holder. This copyright holder could be a publisher or any other business representing by the work's creator. This is often called 'piracy'. Copyright is created when a work is fixed, but the copyright holder can get the money damages only if the owner registers the copyright. Enforcement of copyright will be the responsibility of the copyright holder. Some exceptions are there for copyright which do allow limited use of copyrighted works, and also do not constitute any infringement. For example, the doctrines such as the fair dealing doctrine.

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Trademark infringement

Trademark infringement will happen when one party uses a trademark, which is identical or similar to the trademark owned by another party, for the products or services which are identical to the products or services of the other party. A trademark can receive protection without registration, but when a company registers a trademark, the same provides a legal advantage for enforcement. The infringement could be addressed by civil litigation and could also be addressed in several jurisdictions, under criminal law.

Trade secret misappropriation

Trade secret misappropriation is not similar to violations of other intellectual property laws, as by definition trade secrets are secret, but patents and registered copyrights and trademarks are not secrets but available publicly. Different economic regions or countries have different regulations regarding the infringement of trade secrets.

IPR protection regimes

The technology transfer office cannot proceed with the invention till the intellectual property is available. Inventions with an appropriate intellectual property and market position are generally taken forward. The invention management and commercialisation strategy will start after the intellectual property rights are established. Technology transfer needs a proactive approach, which combines the engaging researchers, technology, and industrial partners to use the technology.

When a technology transfer takes place, there is a very vital question on the relationship with a country's intellectual property regime and the same has some effect on the economic growth of the country. The IPR environment of the country, which is receiving technology could have an important positive or negative incentive for technology owners who are looking for business opportunities. The IPR has some specific economic characteristics, duration and terms of legal protection. These characteristics can impact the technology transfer, on the basis of the level of development attached to the technology recipient.

When it comes to the IPR, the international harmonization is a very crucial facilitator for achieving protection at the international level. The Paris Convention for the Protection of Industrial Property (the Paris Convention), the Patent Law Treaty and the Patent Cooperation Treaty are some examples of the same.

The level of IPR protection is usually found to be more in developed countries in comparison to the developing countries. Thus, the capacities to provide legal remedy, are required in developing countries in case they have to expect international transfers of technology, and develop the domestic innovative firms having significant R & D capacities. The relevance of strong IPRs for innovation and technological development is still a debatable issue.

Technology transfer could be the key development dimension of any international processes, which are related to IPRs. The same can be seen in the work programme of the WIPO. There are attempts to establish an operational framework for the technology transfer and its implications to IPRs which have been undertaken by Draft International Code of Conduct on the Transfer of Technology of UNCTAD, and by TRIPS agreement and the WTO with the Working Group on Trade and Transfer of Technology.

Article 7 of TRIPS explains that the IPRs should contribute to 'transfer and dissemination of technology' so as to form a conductive social and economic environment which could balance the rights and obligations. Article 8.2 explains that the countries could prevent practices, which are found to be unreasonably restraining trade and affect the international transfer of technology.

These statements were transferred into a policy practice which led to a change in the technological situation of developing countries. This could be challenging. The positive experiences with the developing countries could lead to a range of policies and outcomes which could guide policymakers away from their rigidness and preconditions. One such example is the experience of Japan, which was successful in technology enhancement with a well-managed patent system along with the favouring licenses for technology transfer through outright restrictions on FDI. Weak IPRs and the identification of technologies that were innovative but were at the end of their IPR life, encouraged creative imitation in the Republic of Korea and improved its technological and industrial capacities. This helped the country to increase domestic research and development in the 1980s, which included strengthening of the IPR regime. Many policies similar to the Republic of Korea's make use of creative imitation and look to transfer technologies, which are accessible and affordable, when seen from an IPR perspective. Countries such as Brazil, India, China and Mexico are good examples of the same.

IPR in India

Intellectual property is seen as a mark of international co-operation, economic growth, benefit sharing, and multilateral trading and commerce.

The balanced Intellectual Property Rights regime can encourage both domestic innovation and knowledge diffusion with the help of international trade, intellectual property protection, and technology transfers. India has an effective balance between rewards for the innovators and fulfilling the interests of the public through the intellectual property laws. There have been some changes in intellectual property laws, in which the complex IP related issues have also come up.

The Federation of Indian Chambers of Commerce and Industry or FICCI has expressed that by 2050, India will aim to be the world's best nation for creation and protection of intellectual property. A platform has to be set up for the same-a body that will:

- Talk about the intellectual property issues to form a constructive policy dialogue
- Be responsible for taking informed policy decisions
- Undertake an extensive research with the stakeholders to assist the government with the submission of the policy briefs which are highly debated policy issues

Moreover, there is a need for continuous interactions with the Intellectual Property Office and Indian Copyright Office in which the intellectual property issues could be highlighted and proactive measures could be taken for timely resolution. One should also have greater transparency when it comes to the working of the Intellectual Property Office and make it at par with the International standards. The FICCI-DIPP Consultative Working Group works on patents/trademarks/designs system in India to achieve this objective.

Consultative Working Group of Trade Marks System in India

The Consultative Working Group of Trade Marks System in India has led to the following:

1. **Online availability of patent database:** This helps the businesses undergo a prior art search and helps in taking informed business decisions.
2. **Online availability of Controller's decision:** This helps in the enhanced transparency for the Indian Intellectual Property Office's procedures for the rejection or grant of intellectual property rights.
3. **E-filing of patent applications:** The intellectual property user community has faced problems because of the mandatory filing of hard copies for the patent applications. The same is a problem for the ones who were not residing in India or residing in places where there are no intellectual property offices located nearby. The e-filing has been initiated by the Indian Patent office. The same was not used on a large scale because of the non user-friendly interface. The consultative process could also help make the e-filing facility better with the increase of a number of payment gateways along with the certifying authorities for digital signatures.
4. **Uniform Protocol:** This was launched with the pre- and post-grant patent oppositions, which made the process more transparent and led to the avoidance of the patent disputes. The Consultative Working Group issues the notification by the intellectual property office of India. The notification mandates all the branches of IP offices to ensure that there is a uniform protocol and ensures that the opponent is served with the copy of reply submitted by the intellectual property owner. This gives the opponent an opportunity to prepare his defence.

Enforcing Intellectual Property Rights in India

Indian IP laws have quite a few provisions for civil, administrative, and criminal remedies for the infringement of the rights. What is needed is the effective enforcement, especially due to the scientific and technological advancements, that have brought in newer ways of circumventing laws. The speed of the technologies evolution and the effect of the same on the enforcement generate a need for effective ways to handle the situation. The Government can thus consider some crucial methods to effectively execute the enforcement of intellectual property rights. Some of these are as follows:

1. **Specialised IP courts and summary trial procedures:** These have been set up for the handling of counterfeit and piracy cases.
2. **Public opinion for Draft Optical Disc (OD) law:** This is aimed at developing an effective enforcement policy, which could relate to the film, music, software piracy with the help of an identification number (ID), which can be allotted to every OD manufactured in India and imported into the country. The ID number could help to conveniently track the potential infringer.
3. The micro, small and medium enterprises, which form an unorganized sector could also enforce the intellectual property rights. The intellectual property facilitation centres have been launched by the Ministry of Micro, Small and Medium Enterprises. The same have been done in association

with partners and industry chambers. This is an important step in this direction. The facilitation centres provide a general advisory, art searching, protection of intellectual property and commercialization, and so on. The corporate organizations, which are a part of the Corporate Social Responsibility (CSR) have to come forward and support the given facilitation centres.

4. The IP fund has to be collected-it aids capacity building and enforcement of programmes.

The Industry and Government have to make concerted efforts to build a robust Intellectual Property Ecosystem for better national growth. There is also a need for a platform to facilitate the consensus building for different stakeholders. FICCI-IP Division has an intellectual property committee, which helps in consensus building, and also in voicing industry concerns and making concerted representations for the proactive resolution of intellectual property issues.

Multilateral policies and technology transfer

International technology transfer (ITT) for the economic development of a country is very crucial. The acquisition of technology and its diffusion enhances productivity growth. The developing countries should rely on the largely-imported technologies, which become a source of new productive knowledge. Maximum follow-on innovation and adaptation happens in developing countries. These processes can bring about technological change in developing nations.

Developing countries have been wanting to use the national policies and international agreements, which could stimulate ITT.

The national policies could range from economy-wide programmes (education) for funding the creation and acquisition of technology, tax incentives for purchase of capital equipment and intellectual property rights (IPRs). The international efforts to encourage ITT started in the 1970s, when some developing countries looked forward to the Code of Conduct to regulate technology transfer under the auspices of the United Nations (UN).

It is difficult to regulate the ITT effectively when there are incentives for owners not to transfer technology, with no adequate return and the issue of monitoring compliance with any rules which are imposed. This explains why the ITT is mediated by the national policies in comparison to the international disciplines. Some of the policies are subject to the multilateral disciplines (subsidies, and IPR policies), the rules in place are primarily constraining in nature as they define limits on what is allowed. Multilateral efforts have been made to identify actions which the governments should pursue to enhance the ITT. In the mid-1990s, multilateral disciplines on ITT-related policies started being generated. The WTO Agreement related to the Trade-Related Aspects of Intellectual Property Rights (TRIPS) called on the countries to enforce comprehensive minimum standards for the IPR protection on a non-discriminatory basis. The same had provisions which related to the ITT. IPRs were formed to contribute to the promotion of technological innovation along with the transfer of technology.

Sell (1998) has described the politics involved and Patel, Roffe and Yusuf (2000) have analysed the nature of the negotiations and their effects on the world economy.

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Multilateral policies were adopted to prevent the abuse of IPRs by rights holders and the use of practices which could adversely affect the ITT. Also, Article 66 speaks of the developed countries' WTO members to provide incentives to their enterprises so that they could promote technology transfer to the less developed countries (LDCs).

In the year 2001, WTO members started a Working Group on Trade and Technology Transfer, which examined the relationship between trade and the transfer of technology and could examine what might be done under the WTO auspices, which could increase ITT for the developing countries. There is a long history of efforts for developing countries to improve the importance of the WTO for development.

The diffusion of knowledge is facilitated by the open trade regime. Firms must have undistorted access to the capital equipment and imported inputs, which could embody the foreign knowledge. In case the technology markets give increasing returns, imperfect competition and externalities, then trade protection becomes important.

Technological change and trade are closely related. With the innovative changes in the patterns of production and exchange and the emergence of new goods and services, there occur changes in tradability, enhancements in productivity, and reduced trade-associated costs. Also the trade promotes international technology transfer and changes the incentives to innovate. Trade policies are very much connected to this link. The multilateral trade policies encourage the interactions. In the multilateral trading system, there is a promotion of the "liberal trade policies, which are the policies allowing unrestricted flow of goods and services. This could further sharpen competition, and thus enhance innovation and breed success as per WTO. The same has also promoted innovation by protecting the intellectual property rights. This has not been flexible or fast to respond appropriately to technological changes. The current structure present in the multilateral trading system was designed in the year 1986 and had been changing till 1994 till the Uruguay Round of the General Agreement on Tariffs and Trade (GATT).This resulted in the creation of the World Trade Organization (WTO) in 1995. In the Doha Round in November 2001, there was a significant change in the world economy which included the expansion of information technologies and the crisis of the sector (which was known as the 'dot com crash'). The countries witnessed deepening of the process of globalization and China became a key player in the world economy, and got incorporated in the WTO in December of that year. The mandate has in it some issues related to the 'modernized' negotiations, which took place in 2005. After a decade, the same has yet not been completed and the regulatory framework is not up to date.

In 1998, these transactions started spreading and the WTO agreed to take on the work programme on the subject. Ever since the international trade flows via the Internet have grown fast and multi-fold. There is a large quantity and variety of goods and services traded, not only with the help of computers, but through mobile devices and other electronic devices. The WTO is still analysing how to address this issue and has not agreed to impose customs duties on the given transactions, which is a good step towards trade liberalization. Thus, there is an urgent need for the multilateral trading system which should have a greater flexibility for the regulations to be able to evolve faster. The same should match the pace of the technological change so as to prevent national standards from overlapping and creating unwanted barriers to trade.

The cross-cutting nature of some issues in the regulation of information technologies (ICTs) needs greater consistency in formulating rules for various activities.

The WTO takes its decision on the basis of consensus and negotiations, which have to be carried out in the modality of 'single undertaking'. Thus the progress is conditional to all member countries who agree on the large number of issues, which could be hampering the conclusion made in the Doha Round.

In 2011, there was a possibility seen for concluding agreements on certain areas of global interest. It was this 'early harvest' that led to the Bali Package in 2013. This enabled the partial adaptation of the regulatory framework, and carried a risk because of the issues related to the strategic importance of some economies who could virtually be taken off the table. One example of this is that several Latin American countries who granted greater concessions in services but the same is conditional to greater liberalization related to the agricultural trade by developed economies.

This cross bargaining power might fade out if the issues are dealt independently. In 2013, 52 countries started negotiating a Trade in Services Agreement (TISA) which was outside the multilateral arena. The aim of the same was to increase the commitments of the WTO's General Agreement on Trade in Services (GATS). Also, the same is aimed at modernizing the content to include telecommunications services, e-commerce, computing, international data transfers, etc. If the TISA has to become a part of the WTO countries, it should represent 90 per cent of world trade in services (which currently is 70 per cent) and its provisions have to be consistent with the General Agreement on Trade and Services (GATS). Plurilateral negotiations are now the second source of flexibility when it comes to WTO. Many areas witness no talks among all members, but witness a participation of only those countries who want to participate. This would have two major limitations. The benefits become limited, because in some cases [in the Agreement on Government Procurement (GPA)] the same apply only to the participating countries and do not affect the other WTO members. When new members join, they do not participate in setting the rules subsequently, but have to accept the conditions which were previously set forth.

The Information Technology Agreement (ITA) negotiation follows the plurilateral format. This involves 80 countries, but does entail the most-favoured-nation clause, in which the commitments are extended to the remaining members of the WTO (which is not the case in GPA). The ITA restricts tariffs on a list of products in some specific sectors. The agreement binds the participants to regularly review the items, which have been covered, and have a preliminary consensus on incorporating new goods in the original list. The same was achieved in July 2015. Till this consensus was reached, the sample covered by the agreement was in force since 1997. When it comes to ITA, the negotiations on e-commerce alone with other issues related to technological change and transfer, include the 'living agreement' concept which is that its coverage could be adjusted periodically so that it does not lag behind innovations. Recently agreed issues include a revision of the list of products included. When it comes to services, commitments could be assumed to be in the form of negative lists (instead of the positive lists which are currently used) as the technology is changing at a very fast pace. Thus, the new services could automatically be covered. In case this is impossible, it becomes necessary to include activities, which did not exist or were not relevant in trade when the GATS was negotiated. Also the adaptation of the regulatory framework

could need further clarification about the modes of supply, as the GATS coverage varies from one mode to another.

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There are provisions for data protection and storage, which are crucial for the Internet trade, e-payments, cross-border provision of services, value chain management, and trade in products which are related to the Internet. Thus, it becomes important to protect security and privacy in the listed areas without unnecessary trade restrictions. In the absence of the multilateral framework, there could be 100 different regulations, which relate to the international data transfer and this overlapping of rules could create barriers to trade. The main barrier includes the restrictions on information transfer abroad and data storage needs in the local servers and the local technological content. There are economies wherein this type of regulation exists, and some such projects are under study, including Argentina, Brazil, Australia, Canada, Korea, China, Malaysia, Russia, New Zealand, Turkey, Venezuela, and some members of the EU.

Innovation and technology transfer have to be promoted without restricting the trade with unnecessary barriers. ITA has various positive impacts, and the need to modernize is gradually becoming apparent. After many attempts, the negotiation of the extended agreement was launched in 2013.

Also, the ITA's coverage has been outdated, when it comes to the technology changes which have affected goods and services and have been included in the agreement ever since it was signed. In the mid-1990s, for example, the cellular phones were used merely to make telephone calls and send text messages, but now they perform multiple functions on the basis of the improved hardware and software, which now helps to use a vast number of available applications through high-speed Internet connection. Some of the products included in the ITA have disappeared-pagers, for instance, have been replaced by cell phones and floppy disks have been replaced by memory cards, USB devices, and cloud storage.

As the speed of technological progress in this sector is extremely high and dynamic, a global approach to ICTs could be promoted, which is in synch with the definition of the Organization for Economic Cooperation and Development (OECD), in comparison to the inclusion-based approach for the harmonized system codes of the ITA, that could provide greater flexibility in adapting to change.

In the year 2015, a preliminary agreement was reached to extend the ITA. This included the latest-generation semiconductors, medical imaging devices, global positioning systems (GPS), telecommunication satellites, and touchscreens. Also, the tariffs have been eliminated, but there are still some significant non-tariff barriers (NTBs), that have increased in some cases (in the case of environmental regulation). Given the global dimension of the ICT industry, standards and conformity assessment procedures are key to the sector's development. The international differences in requirements have increased the costs and delays immensely.

One of the major obstacles in the ICT industry trade are the certain safety measures along with the localization requirements (such as the restriction of the use of foreign encryption systems), that restrict the free flow of information (which is crucial for these activities); discriminatory measures, such as the national preferences in public procurement; restrictive rules of origin; disclosure requirements (technology transfer, source code, sensitive information) subsidies; administrative and technical barriers to

trade. A few new complexities could arise as some of these measures are not under the ITA, but are regulated by some other WTO agreement.

The final negotiations in case of the ITA 2 has to update the coverage and help bring in flexibility in adapting to the technological change in future. It has to help eliminate the non-tariff barriers. It has to promote regulatory harmonization for each area of certification, which is based on the principle of 'global product, global standard, global test, and global certificate', and stress on the use of digital labelling. It has to stimulate convergence with regulations for services and digital content, which relate to the development of ICT devices.

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1.4 TRADE AND INVESTMENT POLICY OF HOST/ SOURCE COUNTRY VIS-À-VIS TECHNOLOGY TRANSFER

It is important to analyse which trade policies could help a country improve its investment and growth. The policies for imports and exports have to be considered for both the host and home countries. For this, a two-by-two approach could be used wherein the needed export and import policies could be listed and compared with the policies, which are already being used by the host country or the 'home' country. 'Home' here refers to the source of the FDI funds but the same could also be understood as the recipient of the final product or source of capital or intermediary goods. This could influence the impact of FDI or domestically-financed projects. The host and home countries might not just be the developed or developing countries.

The issues in the developed or developing countries are almost the same but may be emphasized differently.

The trade policies relating to developing countries are an area of special focus because it is mostly the host countries that are in need of economic growth. Tariffs and non-tariff barriers (NTBs) imposed on the imports can discourage investment. Moreover, high barriers to imports could induce tariff-jumping FDI. It is possible that the firms could substitute the FDI sales for exports in case the tariffs are high. Thus, one can say that the tariffs, which were once positively correlated to FDI are now negatively correlated to the FDI. The reason for this change is the new organization of international production in which the MNEs choose to locate their activities in different countries so as to take advantage of cost differences and economies of scale. Tariffs and NTBs could negate the competitive advantages, which are being offered by a host economy. The tariffs could also negatively affect investors' choice of location for the host country. It has been seen in the growth experience of some Asian countries, that the strategic trade policies which use barriers have encouraged domestic investment by compensating the firm for its adaptation costs and risk. This is done primarily when the firm is placed in the host country. The externality faced by the pioneering firms could be corrected by a temporary market power available in the host economy. Nurturing this pioneering or 'infant industries' could lead to some issues for the host country. The host governments have to predict the future of these pioneering companies. They also have to rethink about the comparative advantage in future, which is a difficult task. Also, the industry although a pioneer, has to be internationally competitive or else



Non-tariff barriers: Trade barriers that restrict imports or exports of goods or services through mechanisms other than the simple imposition of tariffs.

Check Your Progress

4. What is intellectual property?
5. What do you understand by trademark infringement?
6. How is patent infringement caused?

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the resources of the host country could be misused. Infant industries might have difficulty growing up. Free entry could help rationalize the market and keep only the efficient firms producing at world prices. East Asian countries are following the strategic trade policies along with the proactive industrial policies which have resorted to open-oriented strategies. Also, the host governments have to identify market failure and cases wherein the investors do not see an opportunity. Some of the policy instruments are available to take care of the externality faced by pioneering firms without the help of trade policies that could create distortions.

Restrictive trade policies could also weaken the positive effects of investment for the host economy. Other barriers to imports, for example the barriers to entry, could increase the market power of the domestic and foreign firms in the domestic market. This could further bring in lower efficiency, and higher consumer prices and the use of 'second-generation' technology. The restrictive trade policy could reduce the FDI-induced backward linkages with domestic firms and any technological spill-overs. Small domestic markets, which have high barriers to import technology could hinder the scale economies which could further limit the potential gains from trade and investment.

The barriers on imports of capital and intermediate goods for technology transfer could also be damaging.

One important issue regarding market access concerns capital and intermediate goods. Export competitiveness of companies needs a state-of-the-art capital and intermediate goods, which should be available at world prices. If one could provide cheaper capital goods, then the international trade will increase the efficiency of capital accumulation.

It can also be said that the high tariffs on inputs could prompt companies to increase local sourcing at a given cost. Domestic firms might not be competitive internationally and foreign firms could be restricted from establishing their businesses locally. Thus, the import-substitution strategies have been seen to fail and also be abandoned. Duty drawbacks and tariff exemptions could be offered to the exporters to reduce the impact of tariffs on capital and intermediate goods. This could promote export-oriented investments in case the system is administered efficiently with no additional costs for exporters. There could be some advantages with the backward and forward linkages between the foreign and domestic firms, when barriers to trade in intermediate goods are low and local affiliates of MNEs are integrated in a global chain of production, which could use the cutting-edge technology. The same is the case with the advanced technologies, which are regularly embodied in the intermediate product imports. Therefore, local firms could see more opportunities to supply, such as advanced intermediates and MNE affiliates who seek to diversify their sources, that will help the domestic firms and their employees to acquire the knowledge and capability needed for their manufacture and use. This increases the 'absorptive capacity' of the host economy. This will further reduce the cost of learning other applications of the new technology and reduce the start-up costs for new investments. The backward and forward linkages could channel technological spill overs in the host economy.

Services are crucial for the economy. FDI in services has now been exceeding the FDI in manufacturing. Many services have been transferred with the help of FDI. The growth of FDI in services is because of the technological progress and the

globalization of production that has increased in intra-firm trade in services. It has been seen that the developing countries have higher barriers to trade and investment in services as compared to the developed countries. When it comes to telecommunications, banking and financial sectors, these barriers are higher.

For developing countries, the services trade liberalization can bring in benefits four times greater than that which could be generated from liberalizing trade in goods. This is because the benefits of liberalizing trade in the services sectors are far more than that of liberalizing the same for goods. Liberalizing services trade could further help promote trade in goods and facilitate the diffusion of knowledge for the key sectors, such as the financing techniques. There are key sectors, such as infrastructure services, which could be of interest to developing countries. The low FDI evident in the developing countries could be explained by the inadequate infrastructure, such as transport services, utilities, telecommunications and legal systems. Imports of infrastructure services technology (that are FDI themselves) could compensate for the lack of local infrastructure and improve the FDI.

The GATS schedules have also provided a useful framework for liberalization of trade in services. This positive list approach will allow the host country to specify scheduled ownership, progression, and competition liberalization commitments for various sectors. The regional and multilateral agreements could also increase the foreign and domestic firms' confidence when it is investing in the host economy.

The positive list approach helps to enhance the degree of flexibility and the degree of comfort for making international commitments. At the same time, a negative list approach is the one in which the country identifies sectors and measures to achieve greater clarity about what is 'n' or 'out'. The services exporters could provide more transparency about the rules for doing business. The negative list could also offer scope to clearly carve out sectors, such as public health, education, and drinking water. The preparation of the list could also need the government to assess all their regulations for consistency with disciplines of national treatment, and so on, which can be useful.

1.5 SUMMARY

Some of the important concepts discussed in this unit are:

- The process by which technology is disseminated is known as 'technology transfer' or 'transfer of technology'. It can take place horizontally or vertically.
- Technology transfer offices can work on behalf of research institutions, governments or large multinationals.
- Technology transfer needs a proactive approach which combines the engaging researchers, technology, and industrial partners to use the technology.
- A contract between a licensor, who could be the holder of a patent, and a licensee who could be an industry partner is known as a license.
- The technology transfer office can grant three types of licenses:
  - (i) nonexclusive
  - (ii) partially exclusive
  - (iii) exclusive

Check Your Progress

7. List two policies on imports that can discourage investment.
8. Why is liberalization of services more beneficial for developing countries than the liberalization of trade in goods?

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- The main methods of technology transfer are as follows:
  - (i) Licensing
  - (ii) Support contract
  - (iii) Joint venture
  - (iv) Franchising
  - (v) Strategic alliance
  - (vi) Turnkey agreements
  - (vii) Equipment acquisition
  - (viii) Management contract
  - (ix) Foreign company acquisition
  - (x) Direct foreign investments
  - (xi) Buy-back contract
  - (xii) Original equipment manufacturer
- Licensing is an agreement wherein the owner of a trademark, patent, or other intellectual property gives permission to a party or a company to use the technology, developed by him (her), in a certain area, for a specific period of time.
- A joint venture is an agreement between two or more companies to execute a particular business, and includes the involvement of mutual assets, risks, management, profit sharing, co-production, services and marketing.
- Franchising involves one company granting the right to use its trademark or business model to another party.
- A strategic alliance agreement allows two or more companies to use the specific skills of each of them for the development of new innovative technologies.
- Equipment acquisition is a simple technology acquisition and, therefore, one of the most common methods of technology transfer.
- Direct foreign investment is the type of transfer, where the foreign company invests in developing countries to create a new market, and remove export barriers to get an access to the cheap labour and cheap resources of the country.
- OEM is a form of subcontracting wherein the local firm begins manufacturing according to the foreign company's specifications.
- Intellectual property is the creation of the intellect for which a monopoly is assigned to designated owners by law.
- Intellectual property rights could include the patents, copyright, plant variety rights, trademarks, trade dress, geographical indications, industrial design rights, and sometimes trade secrets.
- A patent is a form of right granted by the government to the inventor, giving the owner the right to forbid others from making, selling, using, and importing an invention for a limited period of time.
- A copyright gives exclusive rights to the creator of the original work generally for a limited time.

- The industrial design right, which is also referred to as the 'design right' or design patent is a right, which protects the visual design of objects which are not purely utilitarian.
- A trademark is the recognizable sign, design, logo or expression which differentiates the products or services of a particular trader from similar products or services of other traders.
- Patent infringement is generally caused by the use of or sale of a patented invention without permission from the patent holder.
- Copyright infringement could be said to be reproducing, displaying, distributing, performing a work, or making derivative works, without the permission of the copyright holder.

1.6 ANSWERS TO 'CHECK YOUR PROGRESS'

1. The process of disseminating technology or transferring knowledge by a transferor to the recipient is called technology transfer. This transfer of technology takes place from the place of its origin to larger groups of people and places.
2. Technology transfer takes place because of the need of governments, universities and other institutions to share skills, technologies, knowledge, manufacturing techniques and facilities with each other.
3. The commercialization of research is the biggest benefit of technology transfer.
4. Intellectual property or IP refers to the creation of the intellect for which a monopoly is assigned to designated owners by law.
5. Trademark infringement will happen when one party uses a trademark, which is identical or similar to the trademark owned by another party, for the products or services which are identical to the products or services of the other party.
6. Patent infringement is generally caused by the use of or sale of a patented invention without permission from the patent holder.
7. Tariffs and non-tariff barriers (NTBs) imposed on the imports can discourage investment.
8. For developing countries, the services trade liberalization can bring in benefits four times greater than that which could be generated from liberalizing trade in goods. This is because the benefits of liberalizing trade in the services sectors are far more than that of liberalizing the same for goods.

1.7 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What do you understand by technology transfer?
2. What is the purpose of granting multiple non-exclusive licenses?
3. List the methods of transferring technology among nations.

4. What is the disadvantage of strategic alliance?
5. What are the benefits and drawbacks of a turnkey agreement?

Long-Answer Questions

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1. What are the various techniques of technology transfer? List their benefits and disadvantages.
2. What is trademark infringement? When does it take place? Explain.
3. Write an essay on the IPR scenario in India.
4. The trade policies relating to developing countries are an area of special focus. Why?
5. It has been seen that the developing countries have higher barriers to trade and investment in services as compared to the developed countries. Explain.
6. Examine the objectives of intellectual property laws.

UNIT 2 WTO'S TRIPS AND TECHNOLOGY TRANSFER ISSUES

Structure

2.0 INTRODUCTION

TRIPS refers to the international agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) that was agreed upon between the member nations of the World Trade Organization (WTO). This allows the member nations to provide an extensive protection for the intellectual property in case they need it. They are left free to decide an appropriate method when implementing these provisions in their own legal system. If a member nation wants to obtain an access to the huge international markets which are included in the WTO, they have to follow the strict Intellectual Property Rights (IPRs) which were listed by TRIPS. Thus, TRIPS became the most important multilateral instrument for the globalization of the intellectual property laws. The WTO's ensuing agreement analyzed the need for special efforts which have been designed to ensure that developing countries, and specially the least developed countries (LDCs), secure a good share in the growth in international trade. TRIPS also specifies the enforcement procedures, and issues resolution procedures. The protection of the IPRs should meet the objectives which lead to the promotion of technological innovation and the transfer of technology. This goal could be achieved by narrowing the technology gap. As per the past WTO agreements, there are numerous provisions which deliberate on the transfer of technology for the developing and LDCs. Also TRIPS enforcement mechanism is very strong unlike other agreements. The member nations can be disciplined with the WTO's dispute settlement mechanism.

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2.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Describe the WTO and its various trade agreements
- Learn about TRIPS and issues related to technology transfer
- Explain the IPRs standard for environmentally sound technologies (ESTs)
- Discuss the Convention on Bio-Diversity (CBD) vis-à-vis technology transfer
- Understand Loose vs Tight IPR Protective Environment
- Describe the various WTO Articles & provisions on implementation of technology transfer

2.2 WTO, TRIPS AND TECHNOLOGY TRANSFER: AN OVERVIEW

Let us begin by understanding WTO and TRIPS.

2.2.1 Understanding the WTO & TRIPS

The WTO is an international organization which deals with the rules of trade among nations. When a country becomes the member of the WTO, it undertakes to adhere to the 18 specific agreements which have been annexed to the Agreement in WTO. These countries then cannot be a party to any other agreements except for a few plurilateral agreements which are not obligatory. The organization officially commenced on 1 January 1995 under the Marrakech Agreement.



Fig 2.1: *WTO and its Various Agreements*

Among the many such agreements, TRIPS is seen to have the greatest impact when it comes to the pharmaceutical sector and medicines access.

The TRIPS Agreement came into force in 1995 and is by far the most comprehensive multilateral agreement for intellectual property. The TRIPS Agreement



TRIPS Agreement: It is a minimum standards agreement, which allows countries under the WTO to provide more extensive protection of intellectual property if they so wish.

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is the agreement which brought in global minimum standards needed for protecting and enforcing the major forms of intellectual property rights (IPR). This also includes patents. International conventions which have been formulated before TRIPS did not specify any minimum standards for patents.

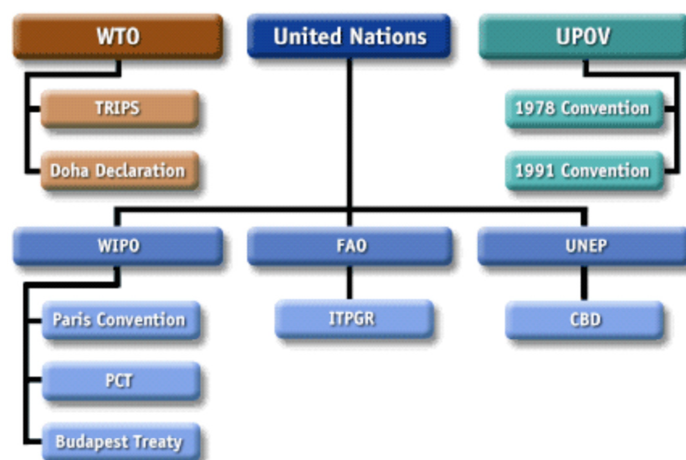


Fig 2.2: *Formation of the WTO and its Various Conventions*

When the negotiations began, there were over 40 countries in the world which did not grant patent protection in case of the pharmaceutical products. The TRIPS Agreement now needs all the WTO members, with a few exceptions, to adapt their laws to the minimum standards of IPR protection. Also the TRIPS Agreement did introduce the detailed obligations for the enforcement for the intellectual property rights (IPRs). TRIPS also has listed the provisions which provide a level of flexibility and space for the countries so as to accommodate their own patent and intellectual property systems as per their developmental needs. Thus, countries could have a level of freedom when it comes to modifying their regulations and they also have some options for formulating their national legislation so that they can have a proper balance among the goal of providing incentives for future inventions.

Key Provisions of TRIPS

The following are some of the key provisions of TRIPS:

a. Patent Protection

The TRIPS Agreement needs the WTO Members to provide a protection for a period of 20 years from the date of filing a patent application for an invention. In the initial TRIPS Agreement, the patent duration was somewhat shorter for many countries. For the developed countries, there is a provision of providing patent terms which range from 15 to 17 years, but in certain developing countries, the patents could be granted for shorter terms that could be 5 to 7 years.

The TRIPS Agreement requires the countries to provide a patent protection when it comes to the processes and products, in relation to all fields of technology. Before the TRIPS agreement, some countries provided the 'process patent' but did not provide the 'product patents'. Product patents provide an absolute protection of the product. At the same time the process patents provide protection only when we

talk of technology and the manufacturing method. The protection for process patents cannot prevent the manufacture of patented products in the process of reverse engineering, where a different process or method from what is being invented is used.

When we talk of national legislation needs, it is only the process patent protection which enables manufacturers of certain countries to get the generic versions for the patented products.

b. Protection of Registration Data Submitted

The sale or marketing permission will require companies to show data which proves the safety, quality and efficacy of the product. The TRIPS Agreement needs the WTO Members to protect undisclosed test data, which has been submitted to regulatory authorities for obtaining marketing approval.

This is a step against the unfair commercial use. As countries have been given considerable discretion to define 'unfair commercial use', it has been argued that countries could meet their obligations to protect test data by the prohibition of 'dishonest' use of data. At the same time, data exclusivity is the need of the TRIPS Agreement.

The data exclusivity approach grants the originator, exclusive rights over their test data and prevents regulatory authorities from relying on the test data to register generic substitutes. Prior to the TRIPS Agreement coming into force, most countries allowed reliance on the originator's test data to approve generic products.

Once test data was submitted by the originator's company, the regulatory authorities can rely on the data to approve subsequent applications on similar products, or rely on the proof of prior approval of a similar product in another country.

Generic manufacturers only need to prove that their product is chemically identical to the brand-name and original product. Sometimes, one may have to prove that the product is bioequivalent.

This approach helps in the swift introduction of generics into the market without registration of data costs. Within the data exclusivity approach, once a company has submitted original test data, no competing manufacturer will be able to access this data for a period of time. Data exclusivity could thus pose an obstacle to effective use of compulsory licenses.

This is because the entry of the generic product would be delayed for the duration of the exclusivity period .The product could also be delayed for the period of time which the same takes in the new compilation of test data.

The public interest is in favour of limiting data protection. This is because the countries want to promote competition and ensure that data protection does not become the means to block timely entrance of affordable generic products for the public health.

c. Transition Periods

The TRIPS Agreement provides for transition periods, permitting developing countries additional time to bring national legislation and practices into conformity with TRIPS provisions. There are three main transition periods:

1. First was the 1995-2000 transition period, at the end of which countries were required to implement the TRIPS Agreement.

2. The 2000-2005 transition period allowed certain countries to delay providing 'product patent protection' in the areas of technology that had not been so protected at the time when the TRIPS Agreement came into operation in that country. These countries were allowed a further 5 years to put in place a product patent regime for technologies and products, which they had not provided so far for the patent protection. This could be done for the products like pharmaceuticals and agro-chemicals. During the transition period, these countries were required to accept patent applications from 1995 onwards and to keep such applications pending, in a patent 'mailbox' until the mailbox was opened in 2005 when the applications were assessed.
3. The third transition period allowed least-developed countries (LDCs) till 2006 to implement their obligations under the TRIPS Agreement for taking care of their economic, financial and administrative constraints.

The transition periods have meant that the products patented before developing countries implemented their TRIPS obligations. Medicines patented after developing countries have implemented their TRIPS obligations are progressively coming onto the market and will constitute an increasing share of marketed medicines.

A substantial change occurred after 2005, when all developing countries started providing patent protection for pharmaceutical products and the mailbox patents were processed.

A major issue as raised by the NGOs and developing countries was the patentability and non-patentability of biological materials which was a major clause of discussion in the TRIPS agreement. Thus the issue of 'patenting of life forms' was crucial.

In 1996, India presented a paper stating that the five types of intellectual protection (IP) which have been covered in TRIPs and are relevant to this context are: patents, layout designs of integrated circuits, plant variety protection, and undisclosed information.



Fig 2.3: *IPR in India*

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There are two technologies which are a part of the IP and are distinguished; one which harms and the other which benefits the environment. The use of the technologies which harm the environment should be discouraged, and the one which benefits the environment should be encouraged in the international community.

When it comes to patenting the technologies harmful to the environment, the WTO needs to take measures which discourage their use globally like exclusion from patentability and ban on the commercial use of such technologies.

This could discourage their use globally. The TRIPs agreement understands the reasoning of the same in Article 27.2 and allows exclusion from patentability 'inventions, ban on the commercial exploitation of such a technology. This was done to protect morality, and to protect human, animal or plant life and be fair to the health and environmental issues. This exploitation is prohibited by the law.

TRIPS sets some minimum standards for the regulation by national governments for many forms of intellectual property. This applies to the nationals of the WTO member nations. This agreement on TRIPS was negotiated at the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) 1994 and was monitored by the WTO.



Fig 2.4: *Process of Intellectual Property*

The TRIPS agreement brought in the concept of intellectual property law in the international trading system. This is one of the most comprehensive international agreements which exists on the intellectual property today.

In 2001, developing countries, which were concerned with the approach of developed countries, insisted on the overly narrow reading of TRIP. This lead to an initiation of talks which concluded with the Doha Declaration. The Doha Declaration was a WTO statement which explained the scope of TRIPS, and states that TRIPS has to be interpreted in light of some major goal like promoting the access to medicines for all.

TRIPS needs the WTO members to provide copyright rights, which cover the content producers which include the performers, sound recordings producers, broadcasting firms; geographical parameters, appellations of origin, integrated circuit

layout-designs; industrial designs; patents; plant varieties, trademarks and confidential information.

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Types of Intellectual Property Assets

Copyrights:	Trademarks:	Patents:
Original expressions of ideas	Words, names, symbols or devices that identify a source	New, useful and non-obvious ideas
Business Torts:	**Trade secrets:**	**Contracts:**
Misappropriation, unfair competition, tortious interference	Formula, pattern, or compilation of information kept secret	Private agreements between parties

Fig 2.5: *Types of Intellectual Property Assets*

TRIPS specifies the enforcement procedures, and issues resolution procedures. The protection of the intellectual property rights should meet the objectives which lead to the promotion of technological innovation and the transfer of technology.

This could lead to the mutual advantage of producers and the technological knowledge-users. This is also conducive to social and economic welfare, and leads to a balance of rights. TRIPS was concluded at the end of Uruguay Round in the GATT in 1994.

The inclusion had in it the culmination of a program of the lobbying by the United States which was supported by developed nations. Campaigns of unilateral economic encouragement which come under the Generalized System of Preferences and coercion and specified under the Section 301 of the Trade Act have a crucial role in reducing the competing policy positions which were favoured by the developing countries like Brazil, Thailand, India and Caribbean Basin states.

The United States' strategy that links the trade policy to intellectual property standards could be related to the entrepreneurship of senior management at Pfizer which goes back to the early 1980s. This act mobilized the firms in United States and maximized the intellectual property in the trade policy. The GATT became the basis for the establishment of the WTO. The ratification of TRIPS was a crucial need for the WTO membership. If a country was wanting to obtain an access to the huge international markets which were included in the WTO, then they had to follow the strict intellectual property laws which were listed by TRIPS. Thus, TRIPS became the most important multilateral instrument for the globalization of the intellectual property laws. Unlike other trade agreements, its enforcement mechanism is very strong. Countries can be disciplined with the WTO's dispute settlement mechanism.

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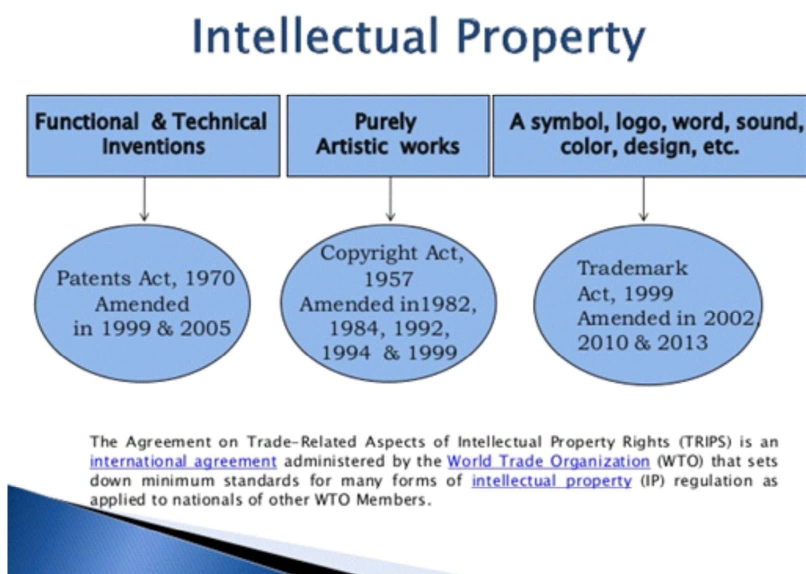


Fig 2.6: *Intellectual Property Areas*

Intellectual Property Areas

The intellectual property areas which TRIPS covers include copyright and related rights, trademarks geographical indications, service marks; appellations of origin; patents, industrial designs including varieties of plants protection; layout-designs of integrated circuits; and trade secrets and test data.

Features of TRIPS Agreement on Intellectual Property

The main features of TRIPS are as follows:

1. **Standards:** When it comes to the main areas of intellectual property which are covered by TRIPS, the Agreement has the minimum standards of protection which have been provided to every Member. The elements of protection have been defined which include the subject-matter which is to be protected, the rights and the acceptable exceptions to these rights, and duration of protection. This Agreement has set some standards which have been reiterated from the substantive obligations of the conventions of the WIPO, the Paris Convention for the Protection of Industrial Property and the Berne Convention. This pertains to the Protection of Literary and Artistic Works. The only exception is the provisions of the Berne Convention on moral rights, and all the other major provisions of the listed conventions have been incorporated by reference and have become an obligation under the TRIPS Agreement .This pertains to the TRIPS Member countries. The relevant provisions, seen in the Articles 2.1 and 9.1 of the TRIPS Agreement, are related to the Paris Convention and to the Berne Convention. Also the TRIPS Agreement lists some major additional obligations on issues where the pre-existing conventions have been silent or have been inadequate to decide. The TRIPS Agreement is thus known as the Berne and Paris-plus agreement.
2. **Enforcement:** Another major set of provisions tackle the domestic procedures and remedies of the enforcement of intellectual property rights. TRIPS lays

down some specific general principles which are applicable to the IPR enforcement procedures. Also the same contains provisions which pertain to the civil and administrative procedures, special needs, provisional measures, related to bolder measures and criminal procedures. This will entail a specific amount of procedures, detail, and remedies which have to be available so that rights holders can enforce their rights effectively.

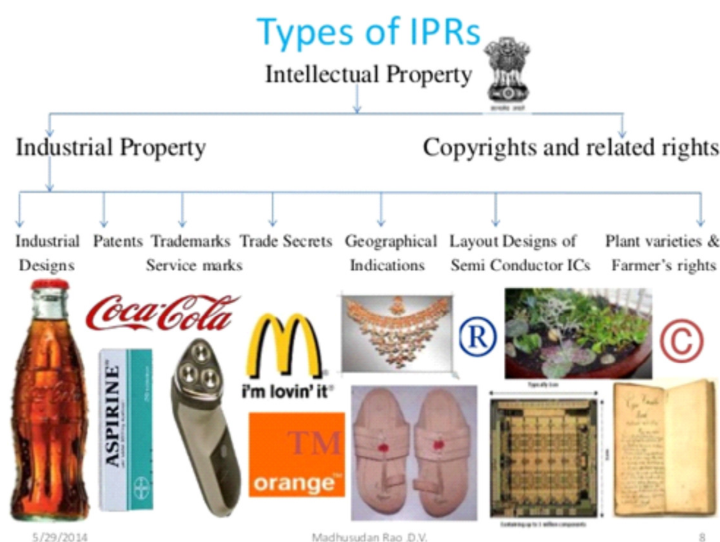


Fig 2.7: *Types of IPRs*

3. **Dispute Settlement.** TRIPS settles disputes among the WTO Members which arise due to TRIPS obligations. This is done in accordance to the WTO's dispute settlement procedures.
4. **Specific Principles:** TRIPS provides some specific principles, like the national and most-favoured-nation (MFN) treatment, and some general rules which can ensure that the procedural problems in acquiring or maintaining IPRs do not overcome the benefits which are present for the Agreement.

Table 2.1: *The Current Membership Status of TPP Parties*

The Current Membership Status of TPP Parties to International Agreements that Provide for Plant-Related Intellectual Property Protection[9]

Trans-Pacific Partnership Party	TRIPS Signatory[10]	UPOV 1991 Signatory[11]	Patent Protection for Plants
Australia	✔	✔	✔
Brunei	✔	✕[12]	Unclear[13]
Canada	✔	✕	Canada does not grant patents on "higher life forms," a term that includes plants, but will grant patents on plant cells and genes.[14]
Chile	✔	✕	✕
Japan	✔	✔	✔
Malaysia	✔	✕	✕
Mexico	✔	✕	✕
New Zealand	✔	✕	No patents on plant varieties
Peru	✔	✔	✕[15]
Singapore	✔	✔	Unclear[16]
United States	✔	✔	✔
Vietnam	✔	✔	No patents on plant varieties[17]

Obligations and Provisions under the TRIPS

There are numerous obligations and provisions under the TRIPS. These are as follows:

1. The obligations under TRIPS would apply equally to each and every Member country, but developing countries would have a longer period to implement them. Special transition arrangements could also be applicable in some situations in which the developing country does not presently provide the product's patent protection in the area of pharmaceuticals.
2. The TRIPS Agreement is basically a minimum standards agreement. This allows the Members to provide an extensive protection for the intellectual property in case they need it. The Members are left free to decide an appropriate method when implementing these provisions in their own legal system.
3. The Marrakech Agreement which was formulated by the WTO analyzed the need for special efforts which have been designed to ensure that the developing countries, and specially the LDCs, secure a good share in the growth in international trade.
4. The same should be of help to their economic development. This goal could be achieved by narrowing technology gap which exists among the developed and developing countries. As per the past WTO Agreements, there are number of provisions which talk of the transfer of technology for the developing and LDCs.
5. In the General Agreement on Trade in Services (GATS), Agreement on Technical Barriers to Trade (TBT), TRIPS, and Agreement on Sanitary and Phytosanitary (SPS) Measures, one could find many such provisions. On the basis of the monitoring reports which have been coming from the relevant WTO bodies, the module can discuss many such provisions.
6. A summary of such provisions have been prepared by the Secretariat at Members and is also stated in crucial documents. The TRIPS Agreement has stated its standards which could affect the transfer of technology and there are a number of provisions which are directly related to the transfer of technology.
7. The Agreement includes statements which pertain to the protection and enforcement of intellectual property rights. The same contributes to the promotion of technological innovation, transfer and dissemination of technology.
8. Also the Article on Principles explains that the Members could adopt measures which could promote technological development in case the given measures are consistent with the provisions of the TRIPS Agreement.
9. The TRIPS Agreement also states that developed-country Members have to provide the incentives to enterprises and institutions within their territories for promoting and encouraging technology transfer for the LDC Members so that they can create a sound technological base.
10. The protection of intellectual property rights has to contribute to the promotion of technological innovation .It also has to contribute to the transfer and dissemination of technology, so as to mutually benefit the producers and users of technological knowledge.

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Table 2.2: *Some TRIPS+ Provisions that can Harm Access to Affordable Healthcare*

	FTA					
Are these TRIPS+provisions present?	RCEP1		USFTAs[1]		EUFTA[10]	EFTA FTAs[11]
	Japanese proposal[12]	Korean proposal[13]	TTP[14]	Singapore[15]	Proposal to ASEAN[16]	
Patents on new uses/forms?	Y	N	Y[12]	N	N	Y (in Korea's)[13]
Prohibition on pre-grant patent opposition?	N	N	N	Y	N	N
Data/market exclusivity on biological medicines?	Y (6 years)	N	Y (5 or 8 years)	Y (depending on definition) for 5 years	Depends on definition	Y (8 years in Hong Kong's)[20]
Patent terms extensions for delays by the patent office?	N	Y	Y	Y	N	N
Patent term extensions for delays in marketing approval?	Y	Y	Y	Y	Y	Y (in Ukraine's)[21]
Linkage?	Placeholder	N	Y[22]	Y	N	N
Limitations on compulsory licence grounds?	N	N	N	N	N	Some (eg. in Jordan's [23])
Bans on parallel importation?	N	N	N	Restricted	N	N

11. This has to be done in a manner which is conducive to social and economic welfare, and the same can balance the rights and obligations. Appropriate measures are needed to prevent the misuse of intellectual property rights from the right holders or for the practices which could restrain trade and negatively affect the international transfer of technology. The Members agreed that the licensing practices and the conditions which are related to the intellectual property rights could restrain competition and may have a negative effect on trade. This could also slow down the transfer and dissemination of technology.
12. It was also stated that nothing in this Agreement could prevent the Members from specifying in the legislation, licensing practices which could affect the intellectual property rights and lead to a negative effect on competition for the relevant market.
13. Thus, a Member has to consistently adhere to the provisions in the Agreement, and take the measures for prevention and control of such mal practices, that include exclusive grant back conditions, conditions which prevent challenges to validity, coercive package licensing, etc. This could be done as per relevant laws and regulations of the Member.

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14. Every Member should enter, into requesting consultations with the Member who believe there is a violation to the requesting Member's laws and regulations for a given subject matter.
15. Thus, one could secure compliance with this legislation, without prejudice to any action under the law .This would also give full freedom of the final decision of either Member. This member could address and will get sympathetic consideration to, and will be given adequate opportunity for the consultations with the requesting Member.
16. This member should then cooperate with the supply of publicly available non-confidential information which could be of relevance to the matter in question .This could also be done for the information available to the Member, which is subject to domestic law and could get to a mutually satisfactory agreement which safeguards the confidentiality of the information by the requesting Member.
17. Developed country members have to provide incentives to enterprises which fall in their territories for promoting technology transfer to the least-developed country Members so as to help them create a sound technological base.

Implementation of TRIPS

The implementation of the applicable changes is done in the following ways:

1. The obligations within TRIPS apply to all member states. When it comes to the developing countries, they were allowed extra time for the implementation of the applicable changes as per their national laws.
2. This was done in two tiers of transition as per the level of development of the country. The transition period in case of the developing countries was extended till the year 2005. The transition period for the least developed countries (LDCs) for implementing TRIPS was extended to 2013 and till 2016 for pharmaceutical patents.
3. These countries were also given a chance of further extension. Thus it can be seen that TRIPS standard were made for the strict intellectual property systems to be created among all countries and the same was detrimental to poorer countries' development. The strategic interest of most of the underdeveloped nations was to gain a flexibility which was available from TRIPS to legislate the weakest IP laws possible for these developing nations. This did not happen in most cases.
4. In 2005 report which was made by WHO it was found that many developing countries did not even incorporate the TRIPS flexibilities like compulsory licensing, limits on data protection, broad research usage, parallel importation, along with other exceptions to patentability into their legislation for authorizing the same under the Doha Round. This could be due to the lack of legal and technical expertise needed to draft legislation. This could have led to implementing the flexibilities, which could help the developing countries copy developed countries' IP legislation directly. Thus the developing countries could have been dependent on the technical assistance. Thus some organizations have a stronger intellectual property monopoly. However, TRIPS has had a positive effect on R&D expenditure when it comes to the pharmaceutical firms.

Table 2.3: TRIPS Flexibilities

Flexibilities of public health interest	TRIPS Agreement articles	Definition
Transition period for granting pharmaceutical patents	65, 66 and paragraph 7 of the Declaration on the TRIPS Agreement and Public Health (Doha Declaration)	A transition period of ten years (until 2005) is specified for a developing country that did not grant patents for pharmaceutical products and processes before January 1995; least-developed countries that did not grant such patents before January 1995 have until 2016 to make this transition.
Parallel imports	6	Products imported into a country without the authorization of the patent holder in that country when the product is put on the market abroad by the patent holder or a third party with the patent holder's consent.
Experimental use	30	Use of the patented invention for scientific purposes.
Bolar exception (early working)	30	This allows a company to complete all procedures and tests required to register a generic product before the original patent expires.
Compulsory licensing	31	This refers to authorization given by a judicial or administrative authority to a third party for the use of a patented invention, without the consent of the patent holder.
Health ministry participation in analysing pharmaceutical patent claims	8 (implicit)	Pharmaceutical patent claims are submitted to health ministry professionals for analysis and approval.



Fig 2.8: *Various Aspects of Patent*

Post-TRIPS Expansion

Apart from the basic intellectual property standards which have been created by the TRIPS agreement, some nations have engaged the bilateral agreements for the adoption of higher standard of protection. These standards, are known as TRIPS+ or TRIPS-Plus, and could take many forms.

The general objectives of the agreements are as follows:

1. The creation of anti-circumvention laws for the protection of the Digital Rights Management Systems. The same was done with the help of 1996 World Intellectual Property Organization Copyright Treaty (WIPO Treaty) along with the WIPO Performances and Phonograms Treaty.

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2. Strict restrictions to be made on the compulsory licenses for patents.
3. Aggressive patent enforcement is to be done. This has been majorly proposed for WIPO and European Union rules for the intellectual property enforcement. The 2001 EU Copyright Directive also implemented the WIPO Copyright Treaty.

Certain General Provisions

1. The pre-existing intellectual property conventions have a specific obligation which is as per the treatment of the protection of intellectual property .This has been provided under the Agreement, to the persons of other Members.
2. Here one could mention Article 1.3 which specifies who these persons would be. These persons known as 'nationals' will include the natural or legal persons, who have an attachment to the other Members.
3. A criteria has been decided for specifying as to which persons will benefit from the treatment. The same has been provided under the Agreement and the same also applies to the main pre-existing intellectual property conventions of WIPO.
4. This does apply to all the WTO Members irrespective of whether they have been a party to some conventions or not. The Paris Convention, Producers of Phonograms and Broadcasting Organizations, International Convention for the Protection of Performers, the Berne Convention, and the Treaty on Intellectual Property in Respect of Integrated Circuits are some of the conventions in which the member could or could not have taken part.
5. Articles 3, 4 and 5 of TRIPS list the most fundamental rules which will apply on national and foreign nationals. These rules apply to all categories of intellectual property which have been referred to by this Agreement.
6. The obligations in these rules of the Treaty cover the substantive standards of protection. They also cover the matter related to the availability, scope, acquisition, maintenance and enforcement of intellectual property rights.
7. It also pertains to the matters which effect the use of intellectual property rights .This has also been addressed in the Agreement. It is the national treatment clause that does not allow any discrimination among a Member's own nationals and the nationals of other Members.
8. The clause of the "Most-Favoured-Nation (MFN) treatment" does not allow any discrimination among the nationals of other Members. When it comes to the national treatment obligation, some exceptions have been allowed under the pre-existing intellectual property conventions of WIPO.
9. These have also been allowed under TRIPS. In case of exceptions, TRIPS allows material reciprocity, with a consequential exception to MFN treatment. One example of this could be the comparison of terms for copyright protection which exceeds the minimum term needed by the TRIPS Agreement which has been specified under the Article 7(8) of the Berne Convention. The same has also been incorporated in the TRIPS Agreement. Some other specific exceptions to the MFN obligation have also been provided for, in those agreements.
10. The major aims of the TRIPS Agreement have been listed in the Preamble of the Agreement, which include the basic Uruguay Round goals which have been

established in the TRIPS area by the 1986 Punta del Este Declaration and the 1988/89 Mid-Term Review.

11. The given aims include the reduction of distortions and impediments to international trade, an effective protection of intellectual property rights, measures and procedures which could effectively enforce the intellectual property rights and reduce the barrier of legitimate trade.
12. The given objectives can be read in relation to the Article 7, which is known as 'Objectives'. As per this article, the protection and enforcement of intellectual property rights will contribute to the technological innovation promotion and help in the transfer of technology.
13. This will bring mutual benefit to the producers and users of technological knowledge. This will also help the social and economic welfare, and will try and balance the rights and obligations of trade.
14. Article 8, which is known as the "Principles", analyzes the rights of Members who should adopt measures for public health and prevent the abuse of intellectual property rights. The same can be done in case these measures are consistent with the provisions listed in the TRIPS Agreement.

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The Basic Requirements of TRIPS

TRIPS needs the member states to have a strong protection for intellectual property rights. Under TRIPS, the following hold true:

- Copyright terms have to extend to a period of 50 years, unless the same pertains to the life of the author.
- Copyright has to be granted automatically, and will not rely on any formality, like the registrations, which had been specified in the Berne Convention.
- Computer programs have to be seen as literary works when it comes to the copyright law and the same will receive the same terms of protection.
- National exceptions to copyright like 'fair use' in the United States could be constrained by the Berne three-step test.
- Patents have to be granted for 'inventions' for all the 'fields of technology' which meet the patentability requirements. The same has to be enforced for at least 20 years.
- Exceptions to the exclusive rights have to be limited, which will thus provide a normal exploitation of the work. The normal exploitation of the patent will not be a conflicted.
- There should be no prejudice to the interests of the right holders for the computer programs and patents which have been allowed.
- The third parties' legitimate interests could be considered by the patent rights.
- The intellectual property laws in each state might not be of any benefit to the local citizens. The same are also not available to the citizens of other TRIPS signatories in the principle of national treatment .TRIPS has the "most favoured nation" clause.

These trademark and patent provisions have been modelled in the Paris Convention for the Protection of Industrial Property. The same is the case in protection of software and database.

Article 10 of TRIPS stipulates that:

1. Computer programs, in source or object code, have to be protected as "literary works" which has been specified under the Berne Convention (1971).
2. The Compilations of data which is in machine readable or any other form, which constitute intellectual creations have to be protected as such.

   This protection, will not extend to the data or material but has to be done without prejudice to any copyright which is present in the data or material.

Software Patents

The TRIPS Article 27, which lists the requirements for patentability 'in all fields of technology', is crucial in granting of software and business method patents. The requirements are as follows:

1. As per Article 10 of this agreement, the appropriate instrument which protects software is the author's right. This instrument has been confirmed by the US Supreme Court.
2. Developing nations have criticized TRIPS. Also many member countries have been against the WTO. Also there are members who advocate trade liberalization and take TRIPS to be a poor policy.
3. One reason for the same is TRIPS's wealth concentration effects. This includes moving money from the developing countries to the copyright and patent owners of the developed countries. This also imposes the artificial scarcity on the citizens of countries who might have had a weak intellectual property law.
4. Also there is a failure of TRIPS when it comes to enhancing the investment and technology flows for the low-income countries. This is a benefit given to the WTO at the time of the agreement's formation.
5. World Bank statements show that TRIPS did not lead to a substantial increase of investment for the low-income countries, although it has done the same for the middle-income countries. The patent periods under TRIPs have been very lengthy and thus been criticized for slowing the entry of generic substitutes and competition to the market.
6. Also the illegality of pre-clinical trials, for getting an approval until a patent expires, has been a major driver of growth for the multinationals, and not for the developing country producers.
7. TRIPS is crucial in the process of generation and transfer of technology, knowledge and innovation. This view point has also been supported by United Nations. Findings show that many countries having weak protection could benefit from strong levels of foreign direct investment (FDI).
8. Also, an analysis of OECD countries undertaken in the 1980s and 1990s shows that the total number of products which were registered have increased, but the mean innovation index still remains unaltered.

9. It was discussed in the 2002 Doha Declaration that TRIPS agreement prevented members from taking crucial measure for protecting public health. Less-developed countries have also argued that TRIPS's did have some flexible provisions, like the compulsory licensing.
10. Also the less developed countries have emphasized that their domestic manufacturing and technology industries have seen a setback due to the policy's bluntness.
11. TRIPS plus conditions which have set standards beyond TRIPS have also been scrutinized. FTA agreements have some conditions which could limit the ability of governments to introduce competition for generic producers.
12. United States has also been criticized for advancing protection beyond the given standards which have been listed by TRIPS. The United States Free Trade Agreements which pertains to Morocco, Australia, and Bahrain have also brought in a clause for the need of patents to be available for the known products.
13. The TRIPS agreement has allowed the grant of compulsory licenses which could be done at the nation's discretion. TRIPS-plus conditions pertaining to the United States FTA's with Singapore, Australia, Jordan, and Vietnam have been a restriction on the application of compulsory licenses for antitrust remedies, emergency situations, and public non-commercial use cases.

2.3 TRIPS, TECHNOLOGY TRANSFER AND THE ENVIRONMENT

The Rio Earth Summit in 1992 recognized the importance of the transfer of environmentally sound technology (EST). This was done to help developing countries or countries of the South in achieving sustainable development. However, progress on this issue has been minimal. The patents for such technologies are controlled by the multinational countries in the developed world or the North. Thus, there is no control of the South for developing these technologies on their own. The main obstacle could be said to be the intellectual property regime which has been imposed by the TRIPS agreement under GATT and through the WTO.

United Nations Conference on Environment and Development (UNCED) has also argued that the technology transfer is crucial for developing countries. This is important for their sustainable development. Also the technology transfer has been one of the two important issues in the North-South compact. It was Agenda 21 in the chapter on technology which called for an action to promote and finance the transfer of environmentally sound technologies for the developing countries. The same as per TRIPS should be carried out on favourable terms for the developing countries.

These favourable terms for developing countries included concessional rebates on the transfer of such technology. TRIPs states that these terms have to be 'mutually agreed' upon by all the members and should take into account the requirement of protecting intellectual property rights.

The proper application of such rights could be a major barrier to technology transfer. This could lead to the deprivation of transfer of technology because of much

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Check Your Progress

1. What does the WTO stand for?
2. What do you understand by TRIPS?
3. When did TRIPS come into force?
4. What is the significance of the Doha Declaration?
5. List the key provisions of TRIPS.
6. List some intellectual property areas of the TRIPS agreement.
7. What do you mean by TRIPS-Plus?
8. List some basic requirements of TRIPS for intellectual property rights.
9. What does Article 10 of TRIPS stipulate?

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of its content. It has been seen that there is a fundamental tension within the agreement on technology.

The same needs discussion, pertaining to the operationalization with the Agenda 21 proposals pertaining to technology cooperation, transfer and capacity building. The Southern countries want a cooperation from the North regarding this area.

2.3.1 Conference of Parties and UN Framework Convention on Climate Change

In the year December 2009, in the Conference of Parties (COP 15), the United Nations Framework Convention on Climate Change (UNFCCC) agreed with the Bali Action Plan (BAP) at COP 13 in Indonesia.



Fig 2.9: *Process of Climate Change Mitigation*

This was intended to reach an agreement for a new international climate change that had a set of stated emissions regulations. At Copenhagen, the negotiators who came from 192 countries, raised the issue of significant environmental policy changes that are needed to reduce the effects of global warming and climate change.

The world's major share of emissions is forecasted to be due to the industrialized and developing economies. There is but a disproportionate vulnerability when it comes to the world's poorest nations. Also there are climate change calamities, which one can see and debate. This calls for an important environmental policy change which could be applied for the problem of climate change. It has been proposed that some benchmarks and regulatory frameworks could be made for every nation which intends to enhance environment and wants national concessions on the same.

There is an urgent need of a consensus on the environmental regulations standards for the use of innovative climate change technologies to which many developing nations have no access. There is a dearth of distributed network in case of technologies which bring forward a debate for intellectual property rights (IPR). Based on the successes of the 'G' forums (which include G-8, G-20, etc.), fast and effective responses have

been made for environmental crises and an agreement has been reached on the Africa Action Plan.

The group members in the United States, China, India, European Union, Japan, Russia, Canada, Australia, South Africa, and Brazil account for three-quarters of the total global emissions.

The development of technology transfer is the major theme for the effective climate change abatement strategies. The discussions on environment are done to demonstrate the problems facing dialogue now and in future.

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IPRs as Obstacles to Transfer of Environmental Technology

As discussed, IPR refers to the protection of rights which relate to the owners of ideas and innovation, manufacturing processes, research and development, and technology. The same is also needed for the economic payment and for the use of previously patented items. IPR is a debated topic but the same is a less serious issue when it comes to technology transfer. However, lack of sensitive nature in the IPR has become prevalent due to the issue of nationalism.

The South-North divide or the developed-developing nation divide on the TRIPS agreement has resulted in complicated scenarios. These are as follows:

1. There has been a vast change in the transfer of environmentally sound technology in the South. The international IPR regime has been extremely strict, when it comes to the TRIPS Agreement pertaining to WTO, which can be translated to policies at the national level. The patent holders of these technologies are generally the Northern-centred transnational companies, which can refuse to grant permission to the companies in the South for using technologies.
2. This could be the case even when the South countries are ready to pay high market prices. Thus, the technologies have been available at high prices (because of the monopoly enjoyed by the patent holders, generally the Northern-centred transnational countries).
3. The companies in the South might not be able to afford to pay at such high prices, and in case they do, their competitiveness is negatively affected. Thus, developing countries might find an issue in meeting their commitments when they have to phase out the usage of the polluting substances under the international environment agreements.
4. Companies in the developing world do not have an access to substitute chlorofluorocarbons (CFCs), chemicals that are used in industrial processes as it is used as a coolant, which could damage the atmosphere's ozone layer.
5. This effects the South's ability to meet commitments under the Montreal Protocol, which is an international agreement with an objective of tackling ozone layer loss. It specifies the need of reducing the use of CFCs and other ozone-damaging substances within some specific deadlines.
6. With the Protocol, developed countries did agree to stop the production and use of CFCs till 2000. At the same time, the developing countries had been given a time period of 10-year grace period for stopping the use of CFCs.



Chlorofluorocarbons: They are gases that are used in things such as aerosols and refrigerators and can cause damage to the ozone layer.

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7. There was a fund which was set up to help developing countries for recovering the costs of implementing their phase-out for the CFCs. The Protocol also includes articles on technology transfer which pertain to South and that too in fair and favourable terms.
8. As per the Indian Commerce Ministry, developing countries including India found it difficult to reduce the usage of CFCs. This was because there was a lack of access to the environmentally acceptable substitutes which were controlled by the Northern multinationals.
9. In India, there were five companies which were majorly manufacturing these products and relied on CFCs. These companies were given an ultimatum to close down in case they did not meet the deadline for eliminating CFCs by the year 2010.
10. The pledged technology transfer was fair but the most favourable terms had not been materialized. It was seen that three of the Indian companies formed a consortium and gave a commission to the local institute of technology for producing a substitute for CFCs.
11. This research had been done at an advanced stage and India now does have the local production of the substitute substance which is HFC 134A.
12. The implementation of the same had many barrier due to WTO's TRIPs agreement. It was seen that the patent rights to the substitute had been held with just a handful of multinational companies.
13. These companies did not want to grant permission for the use of technology to companies of the developing countries as they were their competitors. There were Indian companies which were ready to pay the market price and even pay a higher amount for the technology.
14. The multinational owning the patent did not allow the developing nations companies to license until it took a majority stake in the companies' equity. This was unfair to developing countries.
15. The developing countries were been pressurized to join international environmental agreements. This meant that the developing countries would have to take many painful steps in changing their economic policies and altering their production methods.
16. The WTO promised financial aid and appropriate technology transfer to the developing countries on the most favourable terms in the midst of the hard negotiations. This was done to persuade the South countries to sign the agreement.
17. When the agreements came to force, the funds were not given to the developing nations as promised and thus the technology transfer did not materialize.
18. Also in the other forums of the WTO, and agreements like TRIPs there were talks of blocking the South's access to environmental technology. At the same time, the South was pressured to meet full obligations of the agreement like phasing out the use of CFCs (Montreal Protocol) or reduction of emissions of Greenhouse Gases (Climate Change Convention).

19. This was thus an unfair imbalance. The North has not been following its obligation to help the South, but the South did meet its commitments, and the same did cause them an economic dislocation due to the lack of aid and technology.
20. Some developing countries and public interest groups did suggest some remedies to change the international laws pertaining to patents so that the load of IPRs is not fully levied on the environmentally sound technology.

2.4 RELAXING IPRS STANDARDS FOR ENVIRONMENTALLY SOUND TECHNOLOGIES

In the United Nations Conference on Environment and Development (UNCED) or the Rio summit, issues related to technology transfer like IPRs were raised. The South also agreed that IPRs needed to be relaxed in case of an environmentally sound technology (EST).

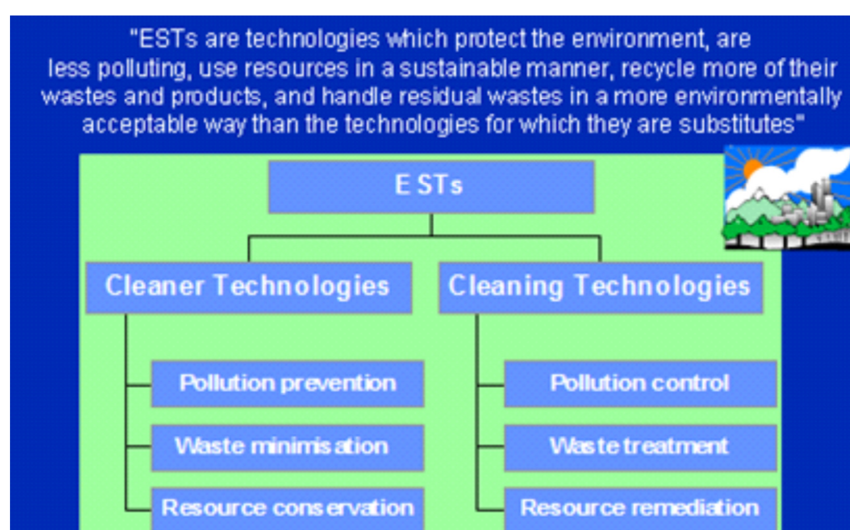


Fig 2.10: *Environmentally Sound Technologies (ESTs)*

This is because the IPRs would be a drawback to South's access to such technology. But the delegations of developed countries have not agreed to this point of TRIPS. There was an agreement on the concessional terms for the transfer of ESTs, but the Northern governments stressed that the IPRs like patents could be applied and this be an exception in IPR regimes for such technologies.

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Check Your Progress

10. What do you mean by environmentally sound technology?
11. Name the countries which account for three-quarters of the total global emissions.
12. Why is the technology transfer crucial for developing countries?

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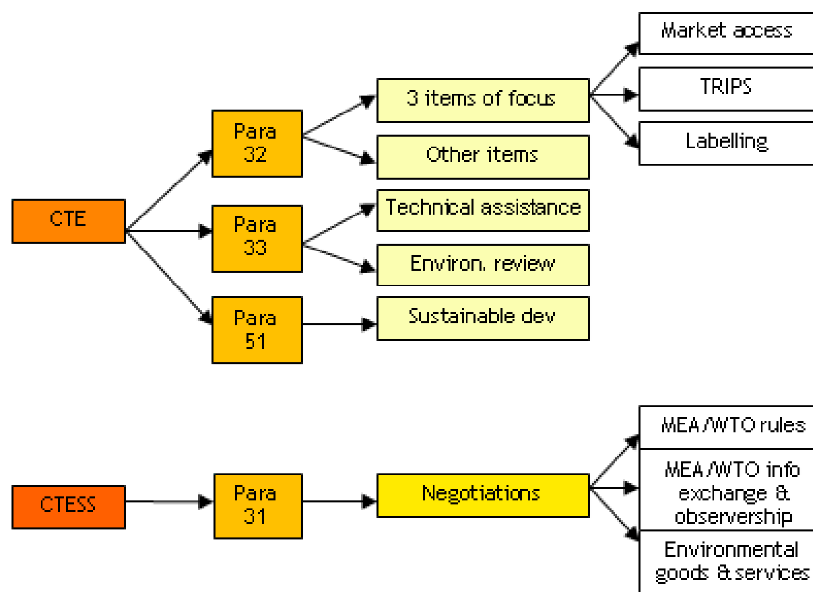


Fig 2.11: *CTE and CTESS*

There was encouragement for the global use of environmentally beneficial technologies. In addition, numerous measures for technology transfer were possible in India with the following assumptions as listed by India. These were:

1. Members have to be excluded from patentability and thus bring in free production and use of these technologies as the same are crucial in safeguarding the environment. This exclusion is compatible with TRIPs and has to be incorporated with the help of a suitable amendment.
2. For the patented technologies currently in use, the Members could revoke patents which have already been granted, and in case this is done then as per the Paris Convention then the same has to be subject to judicial review.
3. For increasing the use of environmentally beneficial technology, the Members of TRIPS should have to be given the liberty to reduce the term of patent protection form 20 years to 10 years. This will help allow free access to environmentally beneficial technologies in a shorter period of time.

In the WTO's Committee on Trade and Environment (CTE), 'TRIPs and Environment' could be further discussed under two issues one being (a) TRIPs agreement and its relation to access and transfer the technology and the development of the environmentally sound technologies; and (b) the TRIPs agreement and MEAs relationships which entail the IPR-related obligations.

The Indian government also suggested to amend the TRIPS accord in the WTO for recognizing the need for the transfer of ESTs for the developing countries' on 'preferential and non-commercial terms'. India tabled an issue of TRIPs for the transfer of ESTs in 16 at the WTO.

2.5 TRIPS AND CONVENTION ON BIO-DIVERSITY (CBD) VIS-À-VIS TECHNOLOGY TRANSFER

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Article 27 of the TRIPS Agreement defines as to which inventions governments can make eligible for patenting. It also authorizes the government to exclude products from patenting. The TRIPS Agreement needed a review in case of Article 27.3(b) that stressed on the debate of plant and animal inventions being covered by patents. It also illustrated how one could protect the new plant varieties.

This discussion was now focused on an area in Paragraph 19 in the 2001 Doha Declaration which stated that TRIPS Council should be looking at the relationship between the TRIPS Agreement and the UN Convention on Biological Diversity. The objective was the protection of traditional knowledge and folklore. There are some proposals being disclosed with the source of biological material and the same is related to the traditional knowledge.

1. Inventions could be patented including the products and processes, and should cover most of the fields of technology. It is also seen that part (b) of paragraph 3 (which is Article 27.3(b)) helps the governments to exclude some specific inventions from patenting, which includes plants, animals and some "essentially" biological processes.
2. Even in this case micro-organisms, non-biological and microbiological processes are to some extent eligible for patents. Plant varieties can be made to be eligible for protection by patent protection or a specific system which could be created especially for the purpose ("sui generis"), or a combination or both.

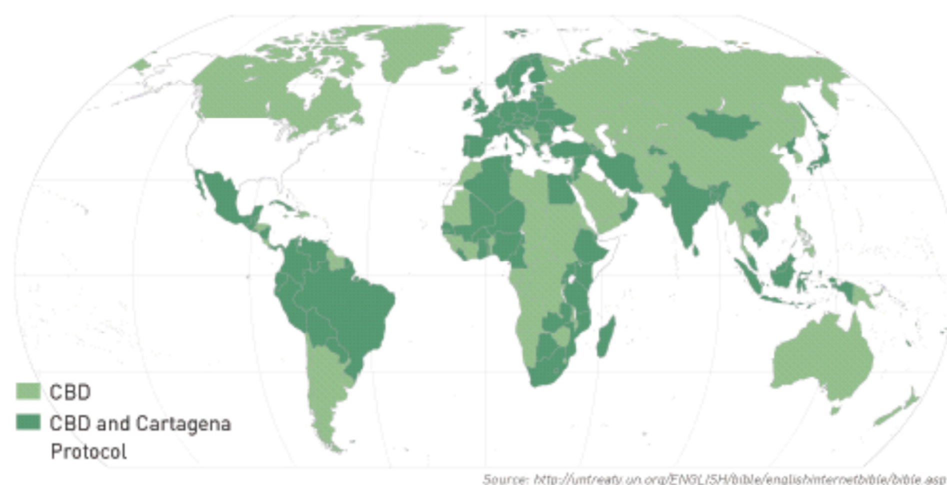


Fig 2.12: Parties to the CBD and the Cartagena Protocol on Biosafety

Issues and Concerns

There were mainly two issues which were mandated in the 2005 Hong Kong Ministerial Conference.

1. One issue was the extension of the products to a higher level of protection for geographical indications beyond wines and spirits (GI extension); and proposals



Geographical indications: It is a sign used on products that have a specific geographical origin and possess qualities or a reputation that are due to that origin.

that state the relationship between the WTO's intellectual property (TRIPS) agreement and the UN Convention on Biological Diversity, which is also known as bio-piracy. Here, on both the issues, the delegations differed in their interpretation of the 2001 mandate. There are still no clear negotiations.

2. Another crucial point is the review of Article 27.3(b) which started in 1999 and was needed by the TRIPS Agreement.

   The main topics of concern in the TRIPS Council have been:

   - Applying the present TRIPS provisions on patenting of plants and animals, and whether these have to be modified.
   - The importance of protection for new plant varieties (which include the alternatives to patenting like the 1978 and 1991 versions of UPOV and the International Union for the Protection of New Varieties of Plants).
   - There has to be a flexibility available, like allowing the traditional farmers to continue to exchange seeds or save them after harvesting them.
   - Moral and ethical issues, like to what extent the invented life forms will be eligible for protection.
   - Dealing with the commercialization of t traditional knowledge and genetic material by the communities or countries from where they originate and the countries where they are used specially when the same are subject of patent applications
   - Ensuring that the TRIPS Agreement and the UN Convention on Biological Diversity (CBD) relate to and support each other.

Table 2.4: *Names of Various Conventions and Year*

Conventions et directives	Place	Date	Abbreviation
Convention on wetlands of international importance	Ramsar	1971	Ramsar
Convention on international trade in endangered species of wild fauna and flora	Washington	1975	CITES
Convention on the conservation of European wildlife and natural habitats	Bern	1979	Bern
Convention on the conservation of migratory species of wild animals	Bonn	1979	CMS
European directive on the conservation of wild birds	Luxembourg	1979	BIRDS
Convention on biological diversity	Rio	1992	CBD
European directive for the preservation of natural habitats and wild plants and animals	Brussels	1992	HFF
Convention for the protection of the marine environment of the north-east Atlantic	Paris-Oslo	1992	OSPAR

The Doha Mandate

In 2001, during the Doha conference, it was clear that the TRIPS Council work which was under reviews (Article 27.3(b) and the TRIPS Agreement with reference to Article 71.1) and the implementation issues had to take care of the relationship between the TRIPS Agreement and the UN Convention on Biological Diversity (CBD).

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Table 2.5: *Unmet Financial Needs to Conserve Biodiversity*

COUNTRY	TOTAL ANNUAL COSTS US$ million/year	UNMET ANNUAL COSTS TOTAL US$ million/year	UNMET ANNUAL COSTS PER KM²* US$ million/year
ASIA			
Indonesia	290	231	120
Malaysia	X	X	X
Thailand	120	60	116
EUROPE			
Germany	1,200	950	2,662
Poland	800	100	320
SOUTH AMERICA			
Guyana	--	--	--
Peru	--	--	--
NORTH AND CENTRAL AMERICA			
Bahamas	110	84	**6,058
Costa Rica	100	81	1,590
Canada	2,686	986	99
OCEANIA			
Australia	--	--	--
AFRICA			
Kenya	160	37	64
Nigeria	593	325	352
Uganda	70	58	245

- They also have to take into consideration the protection of traditional knowledge and folklore. Also the same have to take into account the new developments which the member governments bring in the review of the TRIPS Agreement.
- It can also be said that the TRIPS Council's work has been done on these topics but the same has to be guided by the TRIPS Agreement's objectives (which is stated in Article 7) and principles (as stated in Article 8).The same have to address the development issues.
- The TRIPS Council descriptions have gone into a great amount of detail and have floated a number of ideas and proposals which deal with these complex subjects. Also the topic has also been taking into consideration some informal consultations which have been done with the WTO director-general and his deputies. The issue today stresses on how does the TRIPS Agreement relate to the Convention on Biological Diversity?
- A group represented by Brazil, India , Bolivia, Dominican Republic, Ecuador, Colombia, Cuba, Peru, Thailand, and the African group aim to get changes done in the TRIPS Agreement so that patent applicants disclose the country of origin for their genetic resources and traditional knowledge which are used in inventions.
- They should also provide evidence that they have received 'prior informed consent' (as it is known in the Biological Diversity Convention), and should also provide evidence of 'fair and equitable' benefit sharing.
- Switzerland has also stated a need for amendment to the WIPO's Patent Cooperation Treaty regulations (which is known as WIPO's Patent Law Treaty) in which the domestic laws could ask inventors to show the source of genetic resources and traditional knowledge in case they are applying for patents.
- The failure to meet this need could lead to a refusal to be granted a patent granted and the same when done with the fraudulent intent, could make a granted patent being invalidated.

- The EU's has suggested a proposal to examine a need for patent applicants disclosing the source and origin of the genetic material. This will also have legal consequences if the requirement is not met and is outside the scope of patent law.
- The national legislation uses, include contracts and not disclosure obligation: The United States has stated in the Convention on Biological Diversity that the countries should have genetic resources, and should benefit with this sharing.
- The same could be achieved with the help of national legislation and contractual arrangements which are based on the legislation. This could also entail the commitments of disclosing any commercial application which pertain to genetic resources or traditional knowledge.
- In 2008, the WTO members had 'procedural decisions' for the negotiation of three intellectual property issues in parallel. These were geographical indications issues, along with the 'disclosure' proposal. The members of the WTO did not reach a consensus for the idea.

TRIPS versus CBD

The TRIPS Agreement was the first-of-its-kind when it came to international agreements for governing the protection of intellectual property. It has been seen that patents had been governed completely by national law. The World Intellectual Property Organization (WIPO) was crucial in coordinating the divergent national legislations and the mandated national treatment. It also listed the rights which could be afforded under patent legislation, patent requirement, restrictions, and rights.

Table 2.6: *Zone-wise Parameter of Plants, Insects, Birds and Animals*

Parameter	Zone A	Zone B	Zone C	Zone D
Higher plants	6.2	13.4	9.4	6
Lower plants	0.2	1.4	1	0.4
Insects	7	8	6	2
Birds	2	3.2	2.3	1
Worms	2	2.2	2	1.3
Mammals	0.2	1.3	0	0.2

The same was left to national jurisdiction. Also there has been a great deal of disparity among the countries when it came to protections extensions.

The Convention on Biodiversity took the common heritage of mankind doctrine as the guiding principles for governing control over biodiversity instead of the national sovereignty. The aim was to preserve biological diversity and look at the environmental degradation, for which the Convention formulated a set of international legal guidelines which governed the biological resources worldwide.

Thus, the same needed to reconcile the Northern control of biotechnology with Southern control over biodiversity, and create a framework under which everyone could benefit from the other's endowment.

The Convention understands the sovereign rights of all the States over their natural resources. The same also focuses on making efforts for sharing of genetic resources along with other technologies and innovations that could result from their use.

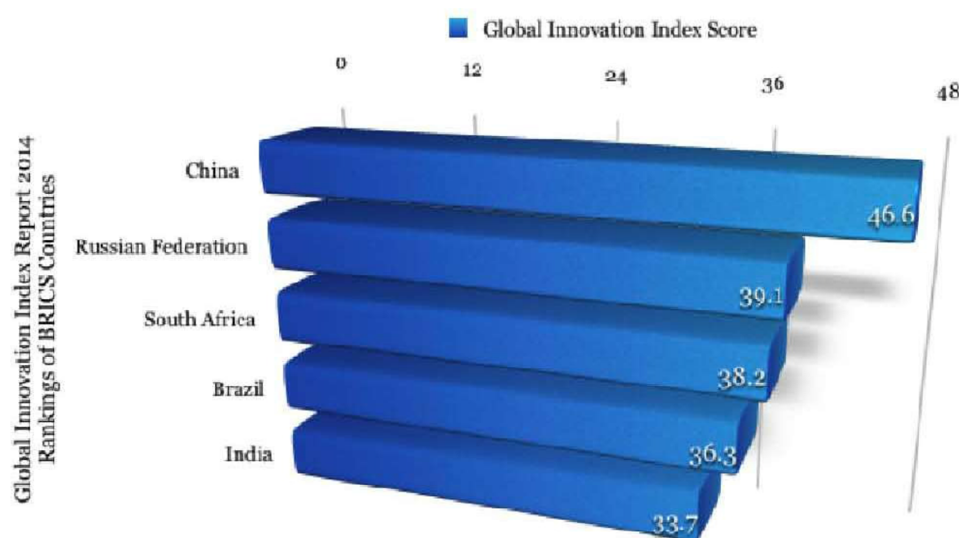


Fig 2.13: *Global Innovation Index Score*

Thus the CBD stipulates that the countries could share genetic resources which come under the national sovereignty as per the general framework. This was established by the agreement, and is subject to specific national legislation.

Also the Parties to the agreement agreed to undertake the policy measures, and had the aim of sharing a fair and equitable method to judge the results of research and development. From this they could benefit from the commercial and utilization of genetic resources associated to the parties which is providing these resources.

The accessibility of the biological resources for the developing world is reliant on the "quid pro quo" transfer of technology from the developed world. This is based on the principle of equity and recognition where the technological development is an essential part of conservation.

Benefits of sharing and technology transfer can be understood by the Articles 16 and 22, which debate on the question of intellectual property rights for the genetic resources. The CBD has many provisions which try and create an environment for benefit sharing.

In Article 15.5, the access to biodiversity has been shown to be governed by the principle of prior informed consent that is known as PIC. At the same time Article 12 states the need of greater education, training, and research which could lead to the conservative use of biodiversity.

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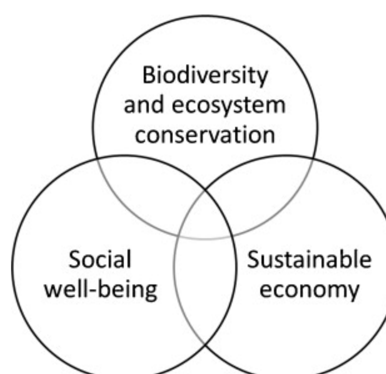


Fig 2.14: *Impact of Biodiversity and Ecosystem Conservation*

There are many measures under the CBD which include public education as is the case in Article 13, technical and scientific cooperation which has been stated in Article 18, and financial support for conservation efforts which has been stated in Articles 20 and 21.

When the technology is subject to patents, then this access and transfer could be provided on terms which are consistent with the adequate protection of the intellectual property rights.

One of the first members of the CBD was Ethiopia and it proposed that the CBD should examine the relationship between TRIPS and CBD. Ethiopia also suggested that the secretariat of the CBD should make a request to the WTO/TRIPS Council for taking into account and accommodating the issues pertaining to the Contracting Parties to the CBD.

The TRIPS Agreement that could have a crucial effect on the innovations of indigenous communities. In 1996, India was the first country which proposed to the WTO that there should be a Committee on Trade and the Environment (CTE) which should be critical in reviewing the consistency between CBD and TRIPS.

India's argument relied on the TRIPS Agreement causing a limited competition for the 'environmentally sound technologies and products', which could drive the prices up and reduce the supplies of these technologies.

India's submitted a proposal for the CBD and TRIPS Agreement being reconciled with the genetic resource disclosure requirement. This could also affect the patent applications, along with the amendment to TRIPS. This proposal lead to a number of international discussions pertaining to the disclosure of genetic resources issues that was already a controversial issue.

There is a group of developing countries like Bolivia, Pakistan, Columbia, Cuba, Brazil and India who submitted a Proposal to WTO in the year 2005 speaking about the relationship between TRIPS Agreement and the CBD. In this proposal, these developing countries spoke about the three types of disclosure requirements which include the disclosure of source and country of origin in case of the genetic materials. The group also spoke about the traditional knowledge that has been used in developing the invention. The same has been claimed by developed nations.

Also there has been a proposal on the disclosure of the evidence, a prior informed consent and the disclosure of the evidence by the 'source' which could be beneficial

for all nations. The 'source' here refers to the country from where an applicant receives the generic material.

At the same time, the 'origin' could be referred to the country for which the generic resource is indigenous. The proposal speaks of the intent of the disclosure requirements which is needed to prevent the grant of bad patents and to promote a better legal certainty.

The revocation of the erroneously granted patent could be very expensive and disturbing in comparison to the disclosure requirements. This disclosure requirements will become critical factors in the patentability of biotechnological inventions determination as per the proponents. This proposal also states that the disclosure of 'origin' could benefit in building a database which could help the prior information which is available to patent examiners along with the general public.

The amendment could make an inclusion for the disclosure requirements that is mandatory for the national laws and regulations .The proposal was an attempt to free the developing countries from the fear of continued bio-piracy. This could be done by increasing the transparency for the use of genetic resources .This could help in enhancing the responsibility to share benefits for all the nations.

2.6 LOOSE VS TIGHT IPR PROTECTIVE ENVIRONMENT VIS-À-VIS- TECHNOLOGY TRANSFER

As has been shown in Figure 2.15, the return from any discovery will depend on two factors. These factors are the cost of replication and the IP protection on that discovery. It can be said that the IPR protective environment could be said to be loose when there is a low or high cost of replication but there is a loose IPR. This leads to weak or moderate appropriability.

At the same time, when the IPR is tight and the cost of replication is low or high, the same could lead to moderate or strong appropriability. This appropriability is concerned with returns which a nation expects when it adheres to the loose or tight IPR.

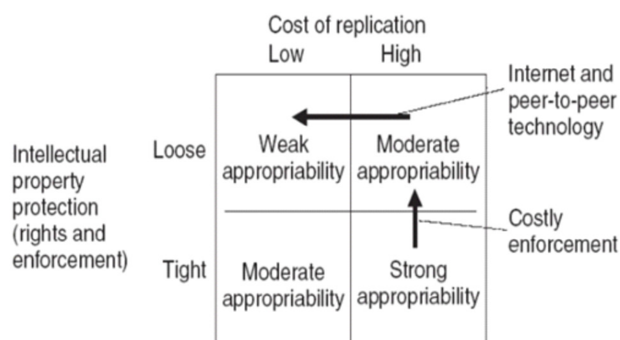


Fig 2.15: *Intellectual Property Protection*

There has been a lot of debate about the impact of alternative IPR regimes which could be tight or loose on the welfare of nations. Many nations have faced this dilemma to justify looser regimes or tighter regimes and their effects on their nation.

Key Dimensions

There are five key dimensions to this issue which have to be weighed before a nation opts for the loose or tight IPR protective environment. These are as follows:

1. Level of IP ownership and generation
2. Trade interconnectedness
3. Machinery to police and protect IP
4. Motivation to comply; and
5. Subversion in the governance system

2.7 ARTICLE 66.2 OF THE WTO'S TRIPS AGREEMENT: IMPLEMENTATION AND TECHNOLOGY TRANSFER

According to Article 66.2 of the WTO's TRIPS agreement, developed country members shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to (least developed countries) LDC members. The move is to enable them to create a sound and viable technological base. As part of the 2001 Doha Ministerial Decision on Implementation-Related Issues and Concerns at the Doha Ministerial Conference, WTO Ministers agreed that the TRIPS Council would put in place a mechanism for ensuring the monitoring and full implementation of the obligations.

Implementation

As a follow-up to the Implementation Decision, in February 2003, the TRIPS Council adopted a Decision on "Implementation of Article 66.2 of the TRIPS Agreement", which detailed information developed countries were to supply by the end of the year on whether and how their incentives were functioning. Since then the TRIPS Council has conducted several such annual reviews, based on reports from developed countries. In addition, since 2008, the WTO Secretariat has been organizing workshops on an annual basis in order to achieve a better understanding of the operation of Article 66.2 and to establish a dialogue between LDC beneficiaries and donors.

The 'Council for TRIPS', having regard to Article 66.2 of the TRIPS Agreement with a view to putting in place a mechanism for ensuring the monitoring and full implementation of the obligations in Article 66.2, as called for by that Decision and with a view to putting in place a mechanism for ensuring the monitoring and full implementation of the obligations in Article 66.2, decided as follows:

1. Developed country Members shall submit annually reports on actions taken or planned in pursuance of their commitments under Article 66.2. To this end, they shall provide new detailed reports every third year and, in the intervening years, provide updates to their most recent reports. These reports shall be submitted prior to the last Council meeting scheduled for the year in question.

2. The submissions shall be reviewed by the Council at its end of year meeting each year. The review meetings shall provide Members an opportunity to pose questions in relation to the information submitted and request additional information, discuss the effectiveness of the incentives provided in promoting and encouraging technology transfer to least-developed country Members in order to enable them to create a sound and viable technological base and consider any points relating to the operation of the reporting procedure established by the Decision.
3. The reports on the implementation of Article 66.2 shall, subject to the protection of business confidential information, provide, inter alia, the following information:
   (a) An overview of the incentives regime put in place to fulfil the obligations of Article 66.2, including any specific legislative, policy and regulatory framework;
   (b) Identification of the type of incentive and the government agency or other entity making it available;
   (c) Eligible enterprises and other institutions in the territory of the Member providing the incentives; and
   (d) Any information available on the functioning in practice of these incentives, such as:
      - Statistical and/or other information on the use of the incentives in question by the eligible enterprises and institutions
      - The type of technology that has been transferred by these enterprises and institutions and the terms on which it has been transferred
      - The mode of technology transfer
      - Least-developed countries to which these enterprises and institutions have transferred technology and the extent to which the incentives are specific to least-developed countries
      - Any additional information available that would help assess the effects of the measures in promoting and encouraging technology transfer to least-developed country Members in order to enable them to create a sound and viable technological base
4. These arrangements shall be subject to review, with a view to improving them, after three years by the Council in the light of the experience.

The Transition Procedures

Utilization by LDCs: In the survey to assess the utilization by LDCs, two LDCs reported instances in which they received technology transfer or other forms of technical and financial support from enterprises and institutions from developed country members. However, it is not clear whether technology transfers are received due to Article 66.2 or purely the result of investment decisions (i.e. without intervention by other WTO members). Also, Uganda found the reports from developed WTO members, specifying how they implemented Article 66.2, difficult to analyze, making it difficult to assess whether developed countries fulfil Art 66.2.

NOTES

Check Your Progress

13. In the CBD, list those issues which were mandated in the 2005 Hong Kong Ministerial Conference.
14. List a few of the Articles which incorporate benefit sharing and technology transfer.
15. Explain the loose IPR protective environment.
16. What does Article 66.2 of the WTO's TRIPS Agreement stand for?

2.8 SUMMARY

NOTES

Some of the important concepts discussed in this unit are:

- WTO's TRIPS is the most important multilateral instrument for globalization of intellectual property laws.
- The TRIPS agreement analyzed the need for special efforts which have been designed to ensure that the developing countries, and specially the least developed countries (LDCs), secure a good share in the growth in international trade.
- The TRIPS Agreement came into force since 1995 and is by far the most comprehensive multilateral agreement for the intellectual property.
- The TRIPS Agreement requires the countries to provide patent protection when it comes to the processes and products, in relation to all fields of technology. Before the TRIPS agreement, some countries protected 'process patents' but did not protect 'product patents'.
- The 2000-2005 transition period allowed certain countries to delay providing for 'product patent protection' in the areas of technology that had not been so protected at the time when the TRIPS Agreement came into operation in that country.
- There are two technologies which are a part of the IP and are distinguished, one which harms and one who benefit the environment. The use of the technologies which harm the environment should be discouraged, and the one which benefit the environment should be encouraged in the international community.
- The Doha Declaration was a WTO statement which explained the scope of TRIPS, and stated that TRIPS had to be interpreted in light of some major goal like promoting the access to medicines for all.
- When it comes to the main areas of intellectual property which are covered by TRIPS Agreement, the Agreement has the minimum standards of protection which have been provided to every Member.
- TRIPS provides some specific principles, like the national and most-favoured-nation (MFN) treatment, and some general rules which can ensure that the procedural problems in acquiring or maintaining IPRs do not overcome the benefits which are present for the Agreement.
- Articles 3, 4 and 5 of TRIPS lists the most fundamental rules which apply on national and foreign nationals.
- The Rio Earth Summit in 1992 recognized the importance of the transfer of environmentally sound technology (EST) to help developing countries attain sustainable development. The period of process on this issue but has been minimal.
- There is an urgent need of a consensus on the environmental regulations standards for the use of innovative climate change technologies to which many developing nations have no access. There is a dearth of distributed network in case of technologies which bring forward a debate for intellectual property rights.

- Since 2008, the WTO Secretariat has been organizing workshops on an annual basis in order to achieve a better understanding of the operation of Article 66.2 and to establish a dialogue between LDC beneficiaries and donors.

2.9 ANSWERS TO 'CHECK YOUR PROGRESS'

1. The World Trade Organization (WTO) is an international organization which deals with the rules of trade among nations.
2. The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) is the international legal agreement which was agreed upon between the member nations of the WTO.
3. The TRIPS Agreement came into force in 1995.
4. The Doha Declaration was a WTO statement which explained the scope of TRIPS, and states that TRIPS has to be interpreted in light of some major goal like promoting the access to medicines for all.
5. The key provisions of TRIPS relate to: a.) Patent Protection, b.) Protection of Registration Data Submitted and c.) Transition Periods
6. The intellectual property areas which the TRIPS agreement covers are: copyright and related rights, trademarks, geographical indications, service marks; appellations of origin; patents, industrial designs including varieties of plants protection; layout-designs of integrated circuits; and trade secrets and test data.
7. Apart from the basic intellectual property standards which have been created by the TRIPS agreement, some nations have engaged the bilateral agreements for the adoption of higher standard of protection. These standards are known as TRIPS+ or TRIPS-Plus, and could take many forms.
8. TRIPS needs the member states to have a strong protection for intellectual property rights.
9. Article 10 of TRIPS stipulates the following:
   (i) Computer programs, in source or object code, have to be protected as 'literary works' which has been specified under the Berne Convention (1971).
   (ii) The compilation of data which is in machine readable or any other form constitute intellectual creations and have to be protected as such.
10. Environmentally sound technology encompasses technologies that have the potential for significantly improved environmental performance relative to other technologies.
11. The United States, China, India, European Union, Japan, Russia, Canada, Australia, South Africa, and Brazil account for three-quarters of the total global emissions.
12. Technology transfer is crucial for the developing countries for economic development and sustainability.
13. There were mainly two issues which were mandated in the 2005 Hong Kong Ministerial Conference. These were:

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(i) One issue was the extension of the products to a higher level of protection for geographical indications.

(ii) Another crucial point is the review of Article 27.3(b) which started in 1999 and was needed by TRIPS Agreement.

14. Benefit sharing and technology transfer can be understood by the Articles 16 and 22, which debate on the question of intellectual property rights for the genetic resources.
15. IPR protective environment could be said to be loose when there is a low or high cost of replication but there is a loose IPR.
16. Developed country Members, under Article 66.2 of the WTO's TRIPS Agreement, shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to LDC Members.

2.10 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write in brief about the processes that led to the formation of the TRIPS Agreement.
2. Why is a strong IPR needed?
3. List various measures involved in the TRIPS agreement to discourage technology that is harmful to the environment.
4. List some features of TRIPS Agreement on Intellectual Property.
5. Write a short note on the obligations and provisions under the TRIPS.
6. Discuss how IPRs emerge as an obstacles to transfer of environmental technology.
8. Write a short-note on India's suggestions for the transfer of EST.

Long-Answer Questions

1. Discuss the significance of the WTO and its various agreements.
2. Enumerate the various types of copyrights that TRIPS needs the WTO members to provide.
3. Discuss the flexibilities provided while implementing TRIPS agreement.
4. How does the TRIPS Agreement relates to the Convention on Biological Diversity? Discuss.
5. Explain Loose vs Tight IPR Protective Environment and their role in technology transfer as incorporated in the TRIPS.
6. Explain Article 66.2 of the WTO's TRIPS and its decision on implementation and technology transfer to the LDC.

UNIT 3 TECHNOLOGY TRANSFER ROUTES

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Structure

3.0 INTRODUCTION

As you have learnt, the process of transferring technology from the places of its origin to wider distribution among people and places is known as technology transfer. It occurs along various levels: from large businesses to smaller ones, across borders, both formally and informally. Often it occurs by concerted effort to share skills, knowledge, technologies, methods of manufacturing, samples of manufacturing, and facilities to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials, or services. In the United States, technology transfer is a fast-growing activity. There are various types of technology transfer and methods to achieve this. There are many market channels and strategies for the transfer of technology.

The transfer of technology by multinational corporations is crucial for developing countries. However, a lot of technology transfer is implicit when it comes to the international trade in goods and services and factors, and it becomes difficult to judge the proportion of prices or flows which have been reflecting in the technology content.

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It could generate both direct and indirect gains when it comes to productivity, product quality, cost reductions, and competition. What is needed for an effective technology transfer is that the needs have to be of absorptive capacity and there should be an ability to adapt foreign technology. In addition, local innovation in developing countries can be an alternative to technology transfer. This unit aims to introduce the basic concepts surrounding the issues involved in technology transfer routes.

3.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Define technology transfer, its types, objectives, methods, etc
- Describe contractual and non-contractual flow of technology
- Explain various routes and market channels
- Examine licensing-JVs, FDI, MOU and bargaining process
- Understand conditions for market and non-market channels
- Explain the significance of imitation and reverse engineering
- Discuss cross-border movement of personnel
- Enumerate the role of outsourcing as an alternative to technology transfer
- Identify the role of local innovation as an alternative to technology transfer

3.2 TECHNOLOGY TRANSFER ROUTES: AN OVERVIEW

According to the authors Carayannis et al., technology transfer generally entails some source of technology which is created and owned by the group possessing specialized technical skills. This group can then transfer the technology to the target group of receptors who do not possess those specialized skills. Thus, they cannot create the tool themselves. In the United States, the technology transfer experience has also shown multiple transfer strategies, some of the most significant being: (i) the licensing of IP rights and (ii) property rights and technical expertise extension to the developing firms.

Technology transfer can be said to be a fast-growing activity which is prevalent in the American research and development system. This has also received substantial attention, be it from industry, governments, and universities.

The exact nature of the activity can be difficult to pin down. This is because the term has many different connotations. Varieties of technology transfer are discussed in business periodicals like Wall Street Journal. These are as follows:

1. **International Technology Transfer:** This is the transfer of technologies which has been developed in one country, and is being transferred to the firms of another country. In the United States, this issue is related to the undesired transfer of weapons technology that could be done to the hostile nations.
2. **North-South Technology Transfer:** These are activities which relate to the transfer of technologies from industrial nations which is done to the less-developed

countries, i.e., the South. The main objective is improving the economic and industrial development which pertains to mainly the poor nations of the world.

3. **Private Technology Transfer:** This entails the sale of or the transfer of a technology from one company to another.
4. **Public-Private Technology Transfer:** This entails the transfer of technology from universities or government laboratories to the given companies.

It can be seen that all four types of technology transfer could be a concern to businesses. This overview would deal mostly with the first two types. It is also evident that in the International technology transfer and North-South technology transfer, these activities have been driven directly by foreign policy along with the national defence concerns. At the same time, the other two types have been driven by the balance of corporate and policy interests.

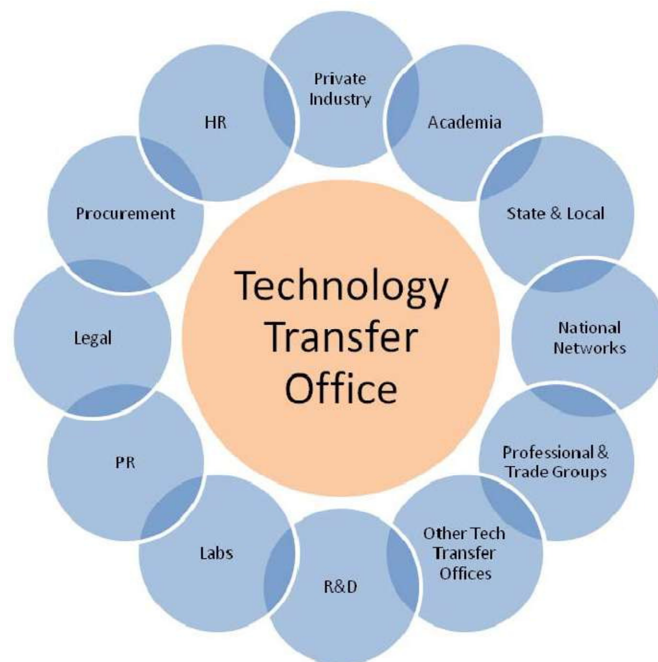


Fig 3.1: *Technology Transfer Office*

Main Segments of Technology Transfer

The main segments of technology transfer involve the transfer of:

1. Technology that is codified and embodied in tangible artefacts
2. Processes for implementing the technology
3. Knowledge and skills which form a basis for technology and for the process of development

The first need for the firm would be to transfer technology and form a legal ownership of that technology with the help of intellectual property law. As you know, there are four generally recognized forms of IP in industrialized nations:

1. Patents that deal with functional along with design inventions
2. Trademarks, which deal with commercial origin or identity

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Licensing: It is a business arrangement in which one company gives another company permission to manufacture its product for a specified payment.

3. Copyrights that deal with the literary and artistic expressions
4. Trade secrets that protect the proprietary capabilities for the firm

Information Activities

There are five information activities that have to be supportive for the technology transfer. These are as follows:

1. **Technology Scouting:** This includes the search for specific technologies for buying and licensing.
2. **Technology Marketing:** This includes the searching for buyers for the technology which is the inverse of technology scouting. This also includes the searching for joint venture collaborators, development partners, investors or venture capital for funding a specific technology.
3. **Technology Assessment:** This includes the evaluation of technology, which aims at answering the question as to what is the technology worth. It also entails the research of the IP, markets and the competitor assessments.

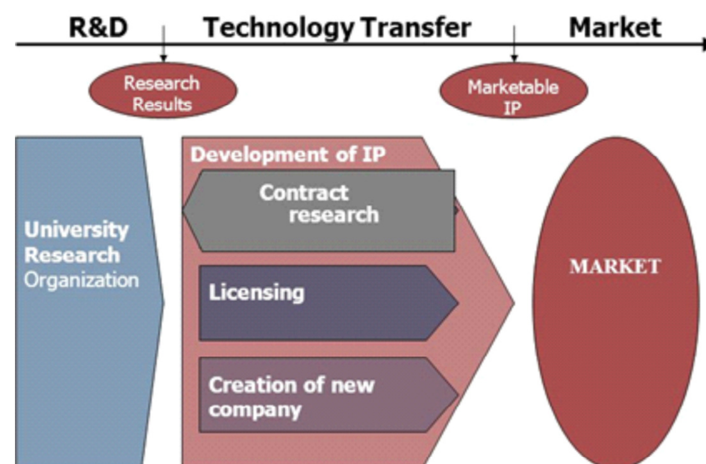


***Fig 3.2:** Technology Transfer - a Link between Research and Industry*

4. **Transfer-related Activities:** This includes the gathering of information for the transfer process like the licensing practices, contracts, terms conducting negotiations, and how can the transfer be made successful
5. **Finding Experts:** This helps to assist in the above areas.

Some takeaways from technology transfer process are as follows:

- The information needs can often be supported by service companies, like licensing consultants, and also be supported by the electronic media, which includes the databases and online networks. Also some of the online networks can use the Internet to help firms for these information activities.
- The information-transfer process could be said to be one of the most critical steps for technology transfer. The new licensing practices are designed to address this method. Like many licenses can bundle the basic technology and the equipment which one needs to use for the technology when it comes to a single agreement.

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- The license could also include a 'know-how' agreement that exchanges the known trade secrets (which have some protections) for the licensee to help in exploiting technology. Some of the industries, such as petroleum exploration, have firms which practice wet licensing, in which the employees of the licenser could be loaned out to the licensee so as to teach the proper use of the technology.
- The main barrier for the increase in technology transfer which is prevalent among firms is organizational behaviour.
- New concepts which are on the lines of knowledge management have been changing behaviours and beliefs. This has led to the firms to realize the major gains which have to be made with the help of the active pursuit of licensing.
- One could start establishing the ownership of the technology, which could be done by several possible legal or contractual mechanisms that are used for the transferring of technology from one organization to another.
- The choice of this mechanism to use a specific technology transaction will depend on the major factors, which includes the stage of development for a given technology. It will also decide what the company will be able to pay for the technology it is receiving. Also the technology and other assets which could be offered instead of money are a part of this decision.
- The possible benefits of having a long-lasting partnership among organizations rather than a one-time transfer could be the exact legal status of ownership over that technology. In case a small firm wants to sell its technology to a large firm for the exchange of money, it might try and license the technology.
- In case the small firm wants an access to the large firm's complementary assets, like the production facilities and distribution network, it has to negotiate a substantial and permanent relationship, like R&D contract and a R&D agreement.

3.3 CONTRACTUAL AND NON-CONTRACTUAL FLOWS OF TECHNOLOGY

The flow of technology could be contractual or non-contractual. For the same, we will study the various types of technology transfer methods.

3.3.1 Technology Transfer Methods

Two major types of technology transfer methods have been listed below:

1. Market-mediated transfer:
    - Trade in goods and services
    - Foreign direct investment
    - Licensing
    - Joint ventures
    - Cross border movement of personnel
2. Non-market technology transfer
    - Imitation and reverse engineering
    - Employee turnover

Check Your Progress

1. List the varieties of technology transfer.
2. List the information activities that have to be supportive for technology transfer.

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- Published information (journals, test data, patent applications)

It is useful to make a distinction between technology transfers that flows through market-mediated mechanisms, which means that some form of formal transaction underlies in the technology movement. At the same time the non-market mechanisms do not involve such transactions. The alternative description could be 'formal' and 'informal' channels, which show the nature of the information trade.

3.4 MARKET CHANNELS AND THEIR ROLE

There are many market channels for the transfer of technology. These are discussed below.

3.4.1 The Principal Routes

The principal routes of enterprise-to-enterprise technology transfer can be listed as follows:

1. **Licensing or Franchise:** Licensing and franchise arrangements could be different for different technical assistance, package of instructions, and training or mere permission for the manufacture or sale of a product.
2. **Supplier of Materials and Parts:** The supplier of materials and parts might just want to provide a full range of information, technical support, and manufacturing knowledge and could be made effective in the technology know-how transfer. This is similar to the industrial licensing arrangement. A classic example would be when we discuss the manufacturers of colour TV sets in India. The manufacturers did not have a formal technology transfer agreement but it was an understanding with the foreign suppliers of materials and components who assisted technically for the production of the goods.
3. **Equipment Supplier:** There are quite a few technological services which are provided by equipment suppliers, which include the operational and maintenance procedures along with the even processing know-how. There are technologies which are machine-based and thus the know-how could be transferred along with supply of plan and equipment.
4. **Outright Purchases:** One example of such an arrangement are turnkey plants. Some other ways of outright purchase are the complete manufacturing, the operational specification know-how, performance data and technical assistance which goes along with the technology transfer.
5. **Acquisition:** This is one method in which the company or business owns the technology through acquisition.
6. **Joint Ventures:** Technology can be transferred by creating joint ventures between two companies.



Acquisitions: It refer to the purchase of one company by another.

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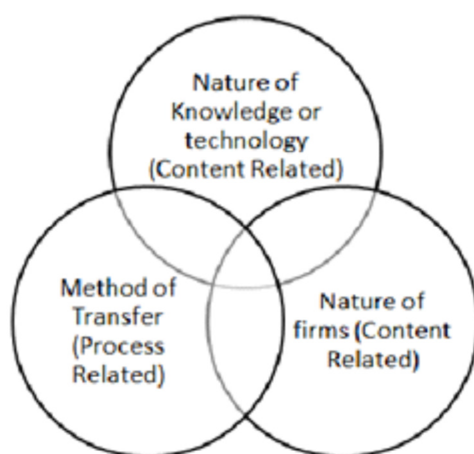


Fig 3.3: *Themes in JV technology Transfer*

7. **Franchising:** Franchising could be done for trademarks and technical, management and marketing knowledge. Licensing and franchise arrangements could be different for different technical assistance, package of instructions, and training, or a mere permission for the manufacture or sale of a product.

Table 3.1: *Franchise Balance*

FOR	AGAINST
- Well known brand name	- Inappropriate or unfamiliar brand name
- Training	- Exaggeration of franchise benefits
- Independent yet size link	- Undelivered promises
- Low failure rate	- Lack of security
- Continuing technology transfer	- Negotiating disadvantage
- Financing support	- Proliferation of outlets
- International network	- Unsuitable technical, managerial or marketing know-how
	- Initial investment excessive

8. **FDI:** Developing countries have made good technological progress but the technology gap between the developed and developing countries has been wide. Here the role of FDI with the help of the transnational corporations (TNCs) have been crucial in narrowing this gap. These TNCs are a major source of high technology activities, knowledge, and research and development (R&D). TNCs can transfer and diffuse technologies of many kinds, including a wide range of hard and soft elements. This can be done by Foreign Direct Investment (FDI) and various non-equity forms of foreign operation.

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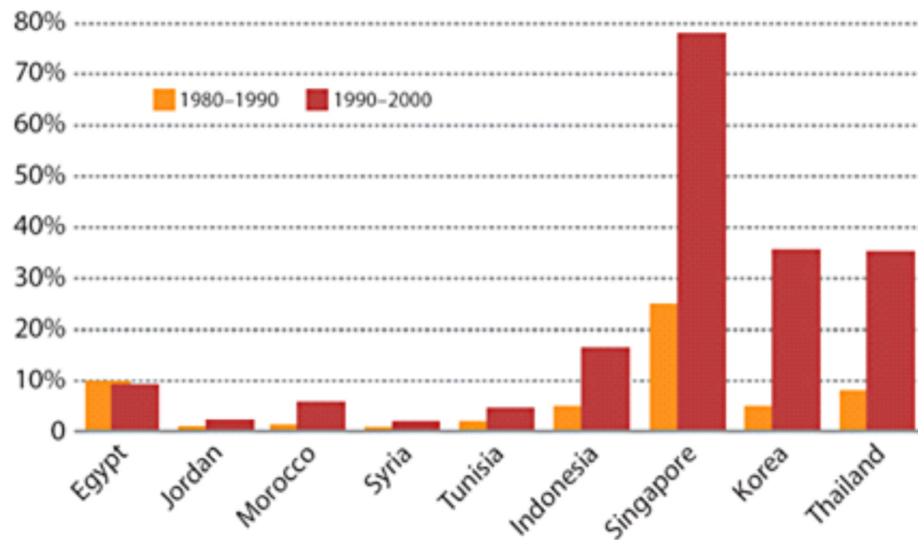


Fig 3.4: *FDI as a Percentage of the GDP*

9. **MOU:** An MOU defines how an intellectual property can be shared. It also defines the roles and responsibilities of the involved parties when one is transferring technology from one country to another. This MOU could be used when one wants to have a collaborative relationship with an outside party. The technology management department of many companies are responsible for drafting MOUs related to collaborative research.
10. **MNCs:** It has been seen that technological changes has led to mechanization and industrialization. This has further led to the economic change and innovation, which has helped in increasing the knowledge and skills, productivity, etc. of the countries. The transfer of technology by multinational corporations is crucial in developing countries. This will be crucial for sustainable development and improve the quality of life. Technological transfer through MNCs is a two-way relationship where it involves technology between and among firms, industries and governments.

3.4.2 Bargaining Process

- The process follows in different ways. These are: Transfer capability of the organization which is supplying the industrial technology could have an important impact on the effectiveness of the technology transfer. The competence of the transfer agents, which includes the ability to design an easily transferable technology package could be a crucial factor.
- The supplier enterprises along with its transfer package show a combination of training, documentation, and technical assistance. The motivation of the technology supplier will rely on the transfer mode and the expected return the supplier expects to realize from an effective transplant.
- Parties can bargain for any number of equitable and logical reasons. Often these will include the issue of risk and such factors as the technology's stage of development (embryonic to fully-developed), the capital investment required, the content and strength of the intellectual property package and an analysis of the market.

Check Your Progress

3. What are the major types of technology transfer modes?
4. List the major routes for the transfer of technology.
5. How does the bargaining process impact the effectiveness of technology transfer?

3.5 CONDITIONS FOR MARKET CHANNELS

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One of the major issues in policy is that the technology transfer flows cannot be measured easily. A lot of technology transfer is implicit when it comes to the international trade in goods and services and factors, and thus, it becomes very difficult to judge the proportion of prices or flows that have been reflecting in the technology content.

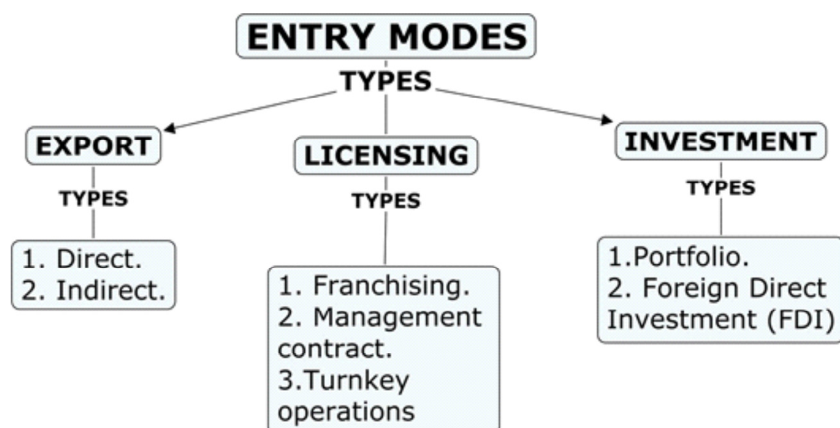


Fig 3.5: *Types of Entry Modes*

The process of technology transfer can be assessed in several ways. These are as follows:

- The imitation goes unreported. Also the spillovers cannot be measured directly. It is difficult for the policymakers to rank-order policies as per the effectiveness.
- The value of some of the technology flows can be listed. These are mostly imperfect measures when it comes to valuing the alternative channels of ITT. This values just provide an informative picture about the trends and shares.
- Irrespective of the channel, low-income countries account for a very small share of total outward flows when it comes to the OECD countries. This share has been further falling over a period of time.
- The total trade with respect to the technology-intensive goods has been growing rapidly in the past three decades. In the same, the capital-intensive exports have been expanding rapidly.
- Upper middle-income nations have made the maximum contribution as the fastest growing market for technology-intensive exports which come from the OECD countries. Licensing along with the types of arm's-length trade in technology which is measured by royalty income flows have been the main domain of OECD countries. These flows cannot be seen to be negligible as they ranged over $70 billion in 2001.
- Upper middle-income countries are crucial players in this market, but they account for merely 3 per cent of the total OECD exports. When it comes to the different channels for ITT, it has been seen that the lower middle-income countries have had the greatest share when it comes to the outward OECD FDI flows.
- It has also been seen that for these countries, FDI shares have been growing faster than technology trade and the trade of the technology-intensive goods. It



OECD: It is an international body made up of 30 member countries that offers a structure/ forum for governments to consult and co-operate with each other in order to develop and refine economic and social policy.

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is the same case for the qualitative conclusion which holds for low-income countries.

- FDI has grown the most between the period of 1970 and 2001. The share of low-income countries in total trade and FDI declined.
- The same conclusion also holds for imports pertaining to the high-income OECD countries. It has been seen that the Upper middle-income countries have been the major suppliers of the technology-intensive products.
- The shifts have been found to be dramatic and shows how the East Asian countries have emerged as the producers of electronic equipment. Also the lower middle-income countries are today the sources of such products. The share of such countries in the OECD market expanded more than their share of the OECD export market.
- Here the categories of middle-income economies have been the generators of technology, which has been quite evident, in the data pertaining to the royalty income of some $12.7 billion in 2001.
- One has to discuss the relationships between the various channels pertaining to the ITT. These channels could be complex when it comes to the trade .Also the FDI often complements, but the FDI and licensing could either complements or substitutes the ITT. There is an allowance of movement of people which is crucial to allow trade, licensing or FDI to enhance the efficiency of transactions.

3.5.1 Channels for Trade

The various channels for trade have been explained below. These are as follows:

1. **Trade in Goods:** It contains the following aspects:
   - The Endogenous growth models assigns a central role to the technological change as per Grossman and Helpman, 1991, which is based on the idea that entrepreneurs can conduct R&D for getting profit from monopoly power, which could result in innovation.
   - Growth can be sustained with the creation of new products which expands the knowledge stock and also lowers the cost of innovation. Also the consumers would be willing to pay a premium for a higher quality (innovative) products. Thus as the new products are a result of new ideas, international trade could help transmit the embodied knowledge internationally.
   - There are some barriers to technology adoption which are a key determinant of international differences when it comes to per capita income as per Prescott, 1994. The increased trade openness can increase the growth of the companies by lowering these barriers.
   - Trade can make a crucial contribution to technology transfer through reverse engineering which can be done by the local firms and granting firms the access to the new machinery and equipment.
   - As per Coe and Helpman (1995, 1997), it was found that foreign R&D which has been embodied in traded goods can have a potential positive impact on the total factor productivity (TFP) pertaining to the importing countries.

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- The impact of the same would be greater if countries are more open and there is more of a skilled labour force. For the same the developing countries will have a larger extent of trade with the developed countries as per Schiff, Yang and Olarreaga, 2002.
- It has also been seen that the investment in R&D has had a greater impact on the TFP with respect to the openness to trade which is prevalent among OECD members. This openness has a potential impact on TFP in comparison to the R&D which has been embodied in North-South trade as per Schiff and Wang, 2002.
- It was also listed by Schiff and Wang that low R&D-intensity industries, and the openness with respect to R&D has a positive impact on TFP. At the same time, it was found out that R&D has a positive effect on TFP when it comes to R&D-intensive industries. This effect, however, is found to be smaller than the same of openness.
- The variations in capital goods trade can be explained better when one notices the cross-country differences in relation to productivity with respect to the overall trade as per Eaton and Kortum, 1999.
- It is these results that suggest that open trade policies are crucial for developing countries and in attracting technology. Openness by itself is not sufficient .What is needed for an effective technology transfer is that the needs have to be of absorptive capacity and there should be an ability to adapt foreign technology.
- These are related to human capital endowments. When it comes to developing countries, technology acquisition will amount to adapting existing methods as compared to local circumstances as explained by Evenson and Westphal, 1995.
- Gradual adoption of new techniques and new inputs can be optimal when it comes to risk-averse producers when it pertains to the costly adoption and unknown returns.
- Producers have to learn to apply new technology and can often start by applying the same to a small part of their output. In case found profitable, there could be an increase in its application gradually over a period of time as per Tybout, 2000.
- The more the technological distance of a country from the global frontier, the more difficult it would become to absorb information effectively in the production systems as per Keller, 2002.
- Most of the countries want to acquire international technology when the domestic firms have the needed local R&D programs. For the same there should be the presence of domestic private and public research laboratories.
- Also there is a need of a sound basis for technical skills and human capital. This reduces the costs of adaptation, imitation, and follow-on innovation.

2. **Foreign Direct Investment:** It contains the following aspects:
   - FDI can provide the developing countries with efficient foreign technologies and result in technological spillovers and greater competition. Along with demonstration effects (imitation), spillovers could also come up like labour

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turnover and vertical linkages. This happens when the MNCs transfer technology to the local firms which are suppliers of intermediates or buyers of their output.

- Case studies show that the substantial technology diffusion could happen due to FDI as per Blomstrom and Kokko, 1997. Econometric studies have been more diverse .Some studies have found out that the sectors which have a relatively high MNC presence could be more productive as per Kokko et al, 1997.
- There are other findings which suggest what domestically-held firms could do worse when there is an increase in the foreign presence in their industry as per Aitken and Harrison, 1994.
- Also the studies on negative spillover effects show that the same could occur in the short run in case the MNCs neglect the domestic demand and do not make use of the high-quality labor.
- Vertical technology transfer which could be done by MNCs with the local suppliers can be documented and can occur through the firms from industrialized countries.
- This could lead to buying the output of Asian firms and selecting the same under the foreign brand names. These type of adjustments could lead to the transfers of technical information which could be done by the foreign buyers.

3. **Licensing:** It contains the following aspects:
    - Licensing is a very crucial source of technology transfer when it comes to the developing countries as per Correa (2003). This involves the purchasing of the production or distribution rights along with the underlying technical information and know-how.
    - The market size, proximity, anticipated growth, human capital, repatriate licensing rents ability, and the investment climate all have an impact on licensing flows. In addition, there are other factors like confidence of licensor firms on the fact that the proprietary technologies cannot disclose the technology in the host economy.
    - It is also known that the transferred technologies could be easily copied, and thus industrial espionage is common. It is also possible that the technical personnel defect to the competitor firms.
    - Thus it is possible that the foreign firms prefer FDI. In case the same is not possible then the firms could choose not to engage into the technology transfer method of licensing or transfer lagging technologies as per Maskus, 2000, Saggi, 1996.
    - Successful transfer could require capacity to learn and investments which can be applying technologies into production processes. The same also explains why countries with substantial engineering skills along with the R&D programs for adaptation and learning have been greater recipients when it comes to licensing flows as compared to others .The same has been explained by Yang and Maskus, 2001.

4. **Movement of People:** It contains the following aspects:
   - There is another method of technological transfer which is the movement of people. This stresses on the role of labour turnover as a main channel of technology transfer.
   - It has been found in some studies that intra-national labour turnover from multinational companies to local firms is limited. The same has been seen by studies conducted by Gershenberg, 1987
   - The ability of local firms to adapt to the new technologies is a major determinant of whether labour turnover could be a method of technology diffusion. What is crucial is the feasibility or the profitability related to creating new companies. The same has been studied by Saggi, 2002.
   - The international movement of people is associated with nationals who are studying or working abroad for a given period of time and are applying their new knowledge in case they return, or there is an inward movement of the foreign nationals into the country.
   - This could be a crucial channel for ITT. The major challenge would be developing countries facilitating temporary movement abroad so as to encourage returnees to get engaged to the local research and business development.

3.5.2 Technology-Related Policies

This incorporates numerous discussions and decisions related to technology. These are as follows:

1. Many countries have been engaged in industry protection. It is argued that the diffusion of knowledge can be enhanced with the open trade regime.
2. Firms should have an access to capital equipment along with the imported inputs which are embodied in foreign knowledge. When it comes to the open markets, the same could also extend to the other products.
3. This association can also increase the competition and reduce the price-cost markups. At a certain period of time technology markets can be associated with increasing returns, imperfect competition and externalities, which can be against trade protection.
4. Thus the conclusions of these discussion depend on the scope of knowledge spillovers. It can be seen that international knowledge spillovers strongly favour the free trade, and the national spillovers form a potential role for trade-policy intervention.
5. In case the productivity improvements are reliant only on a country's own R&D, then a case can be made for policies which ensure that industries in which these improvements occur at a very rapid rate are not located anywhere else.
6. The present evidence shows that the spillovers are generally international as per Eaton and Kortum, 1996. Even in case the spillovers were intra-national, then the trade policies would not be efficient.
7. Also the general policies which enhance the incentives of agents or undertaking such activities which generate social benefits that exceed private returns, without

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creating any distortions, would be better. Trade policy does not encourage local R&D and thus brings in the distortions of the same.

8. Some of the trade policies which are motivated for technology transfer are Trade-Related Investment Measures (TRIMs). The local content and technology transfer needs for foreign investors is just one example of the same.
9. TRIMs includes the discrimination which is done against imports by creating incentives along with import tariffs for sourcing inputs from domestic producers. When it comes to the technology transfer context, a motivation for TRIMs would be that foreign firms are expected to transfer knowledge so that they can ensure that the local inputs which have been purchased satisfy their specifications.
10. TRIMs can be seen as an implicit tariff which is levied on the intermediate goods imports as the manufacturers have to use the higher-cost local inputs. They are considered to be inferior to tariffs when it comes to the welfare terms. This is because no tariff revenue gets generated.
11. They also provide very little or nearly no incentive for the protection of the producers of intermediate goods for acquiring more knowledge.

3.5.3 Licensing and FDI-Related Policies

It has been seen that traditionally restrictive trade policies have been complemented by restrictions on FDI which have been in part to prevent tariff-jumping investment. It has been seen that Korea, Japan, and Taiwan have imposed restrictions on FDI at some points in time. The policies mostly have been welcoming toward many methods of international technology transfer (ITT), which includes the trade policies related to machinery and equipment, and the ones relating to the licensing of foreign technology.

	Franchising	**Licensing**
Governed by:	Securities law	Contract law
Registration:	Required	Not required
Territorial rights:	Offered to franchisee	Not offered; licensee can sell similar licenses and products in same area
Support and training:	Provided by franchiser	Not provided
Royalty payments:	Yes	Yes
Use of trademark/logo:	Logo and trademark retained by franchiser and used by franchisee	Can be licensed
Examples:	McDonalds, Subway, 7-11, Dunkin Donuts	Microsoft Office
control:	Franchiser exercise control overfranchisee.	licensor does not have control over licensee

Fig 3.6: *Franchising and Licensing*

It has also been seen that national FDI policies are becoming liberal but these policies differentiate between joint ventures and fully owned subsidiaries when it comes to multinationals.

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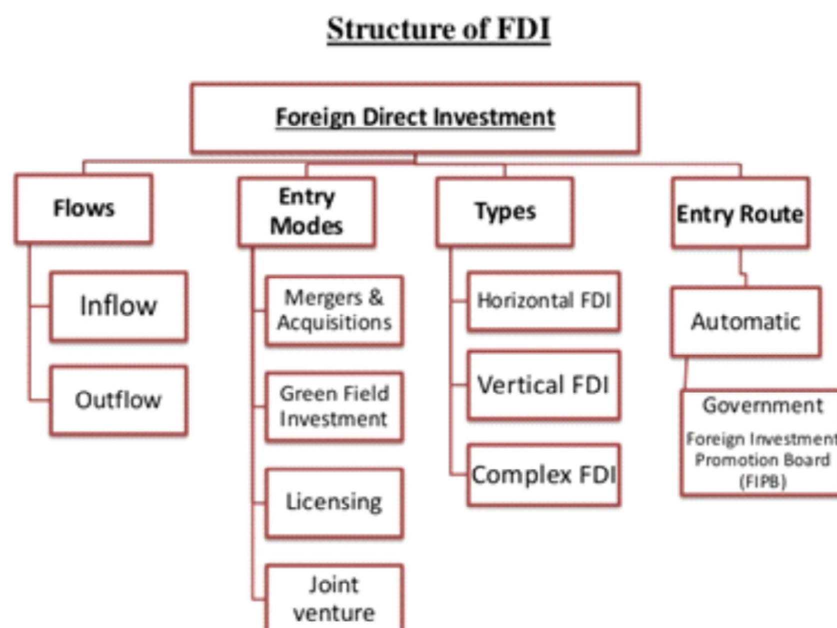


Fig 3.7: *Structure of FDI*

One such example is that of China, which has been encouraging joint ventures which brings in FDI. This policy stance could be an attempt for protecting the incumbent firms from the competing MNCs.

This can also show a desire for maximizing the technology transfer to the local agents. Many studies show that the technologies transferred to the wholly owned subsidiaries can be of a newer vintage as compared to the licensed technologies and the ones which are transferred to joint ventures. These studies include those of Mansfield and Romeo, 1980. So, it can be understood that by forcing MNCs to license technologies, two negative aspects emerge. First, host countries can dread the quality of technologies which they receive, and it will reduces the incentives for the host country to invest in technology.

Here the measure of technology transfer undertaken by the MNCs has to be socially optimal, and there is evidence that such firms will be willing to transfer technology to their local suppliers.

3.5.4 General vs. Specific Domestic Technology-Related Subsidy Policies

Policies which facilitate this process, in comparison to the ones which insist that MNCs do engage in technology transfer to local competitors, can have a better likelihood of being successful. It has been noticed that many countries seek to attract foreign investors with the tax holidays, up-front subsidies, and similar grants. There has to be a rationale for any such investment incentives and the host countries should gain the positive externalities which come from the inward FDI.

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In addition, there is a presence of following a certain leadership behaviour when it comes to MNCs that can be crucial in the case of FDI incentives. Having seen the oligopolistic nature of markets in which FDI occurs, it is possible that the new entrant could attract investments by the present competitors as well as the upstream suppliers. In case this is the scene then the competition can be seen at multiple stages of production and the same can increase enhancing the efficiency and the overall output and employment.

Another implication of the same would be that the host country could unleash a sequence of investments by inducing FDI from one or two major firms. Also the local economy is not sufficient for a well-developed network of potential suppliers, thus the MNCs can be hesitant in investing to the local suppliers as there is a lack of demand.

When it comes to interdependence, growth can get constrained with the problem of coordination that would be resolved somehow by initiating investments from crucial firms. This coordination problem can also be managed alone with the help of investment incentives. The policy efforts have to be focused on enhancing the investment climate and lessening the costs of absorbing the new technology.

This is but a complex task which needs human capital and an expansion of the national innovation system. Thus although there could be incentives involved, the same could be a conditional one. Thus to be effective one has to study the preconditions which are prevalent in the given investment climate and be able to satisfy the absorptive capacity.

3.5.5 Non-Market Channels

The management of technology in developing countries is different from what it is for the developed countries. The need for in the developing countries is not something that is growing from within, but comes up from the new products that are imported from developed countries.

The technological growth will not be a consequence of any inner data and research, but will be a resultant of the technology transmission which comes from abroad. Thus, in these environments, the technology management done in a customary way will not be very effective.

Some of the major issues that developing countries are facing are that the organizations controlling the technology management endure non-compliance. This is the technological development that does not show an estimated accurate trend.

3.6 EXPLAINING REVERSE ENGINEERING

Reverse engineering is said to be the process of discovering the technological principles of a human or non-human made device, object or system with the help of the analysis of its structure, function and operation.

Check Your Progress

6. List the various channels for trade.
7. What is the significance of FDI on technology transfer?

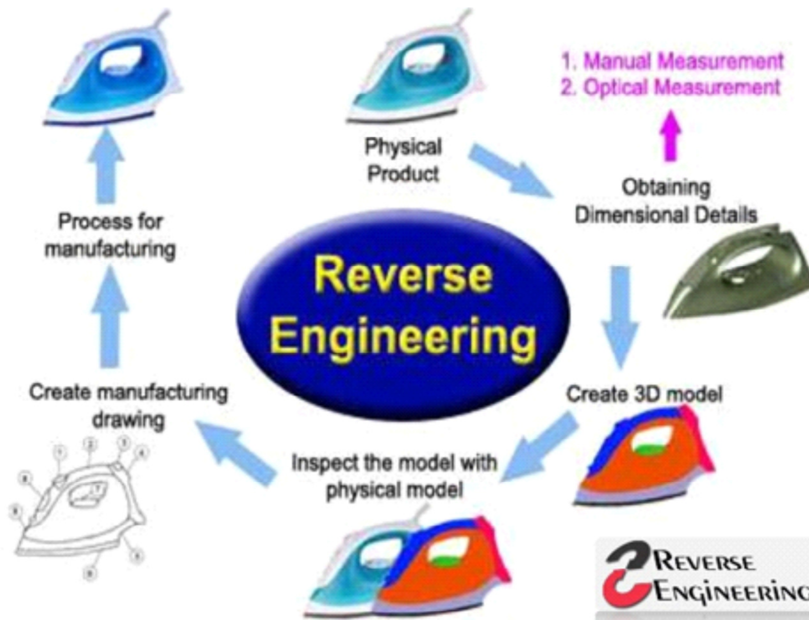


Fig 3.8: Reverse Engineering Principles

This entails taking an object, say a mechanical device, biological or chemical matter, electronic component, or a software program apart and analyzing the working of the same in detail to use it in maintenance, or to try and make a new device or program which does the same functions without simply duplicating the original.

Reverse engineering can be applied for retrieving constituting elements of a product. This could be done when there is a lack of access to the primary design and the same could be used for development, maintenance, and extension of the existing possibilities and re-engineering. This originates from the analysis of hardware that has been used for the commercial or military advantage.

Here the aim of reengineering is to deduce design decisions which are related to the end products with just a marginal knowledge which pertains to the procedures involved in the original production process.

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Reverse engineering: It refers to the reproduction of another manufacturer's product following detailed examination of its construction or composition.

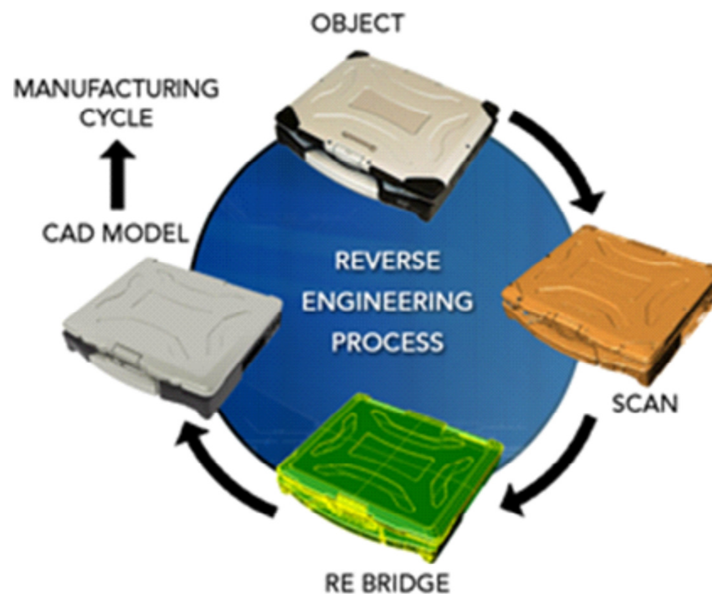


Fig 3.9: Reverse Engineering Process

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This method of technology transfer is an accepted strategy for developing countries. Here one has to note that a lack of technical information protection for the production of the product could be detrimental in this process. Thus, for the same, there are some specific documents and maps which are used to design the product. This is done by a team work of experts and researchers for various basic sciences and suitable management of the research and development setting.

The same is prevalent in the pattern-making and semi-industrial phases along with the product fabrication and production. For the same, the properties, and conditions of designing of products are considered. Moreover, the national and common standard and the unknown points are covered for the same.

Research and development activities can be said to be a generic concept but they pertain to two products which are knowledge and technology. Here the role of research and development activities for generating new technology is crucial. The same can also be explained as the technology is a product that gets produced because of the research and development factories.

Technology could be said to be the master key of development and is thus the most powerful factor when it comes to the economic revolution in societies. This could be said to be the combination of four complex elements which have been explained below:

1. Hardware and machineries
2. Technical knowledge
3. Abilities including human proficiencies and initiatives
4. Technology management and organization

Technology management includes the mechanisms which are crucial in facilitation and effective merging of the above elements. Thus, technology becomes crucial in the national development and plays an important role in the research and development.

3.7 CROSS-BORDER MOVEMENT OF PERSONNEL

One of the significant channels of technology transfer is the cross-border movement of technical and managerial personnel. Sometimes, new technologies cannot be afforded and they do not get transferred without services of the engineers and technicians who have to be on-site for a certain period of time.

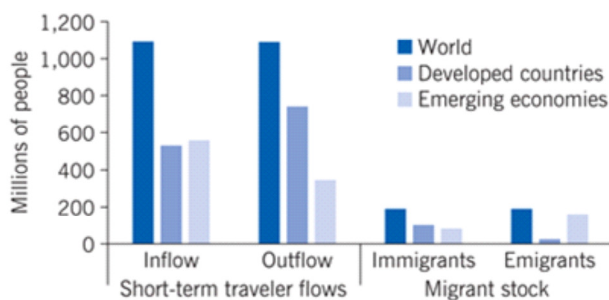


Fig 3.10: *Cross-border Travel Flows and Stocks of Migrants*

Source: Calculations based on data in Manyika et al. Global Flows in a Digital Age: How Trade, Finance, People, and Data Connect the World Economy. New York: McKinsey Global Institute, 2014.

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- The important advantage of the MNCs is that they can shift their skilled personnel to the site of the subsidiaries as and when needed. Markets which cater to the temporary movement of skilled workers, when it comes to unrelated firms, could be very restrictive and less flexible. This can thus raise the costs of a technology transfer and absorption.
- It has also been seen that the trade, licensing, FDI, joint ventures, and personnel movements can all be interdependent processes pertaining to technology transfer. The given decisions are made by the firms which are wanting to maximize returns on their technological assets. Also the policy environments can make an impact on these decisions. This impact could alter the scope and the substitution of the same among channels.
- These processes can be characterized as market transactions. Many times, there are literal buyers and sellers of technology and the aim of the market is to enhance the trade to permit negotiations of mutually advantageous terms of transfer.
- Technology transfer which relates to the multinational firms might not incorporate the same formal terms but these trades should show the true economic value of information for the parent firm and their subsidiaries.
- It can thus be said that the markets for information could be crucial in ITT. One can say that the first approximation, in expanding the scope for technology transfer would be reducing imperfections in such markets.

3.8 CONDITIONS FACILITATING NON-MARKET CHANNELS

Let us now look at the conditions that facilitate non-market channels.

3.8.1 Imitation

There are some crucial non-market channels of international technology transfer (ITT), that have been mentioned here. One of the major process of ITT is the process of imitation. Here the rival firm learns the technological secrets of another firm's formula or products.

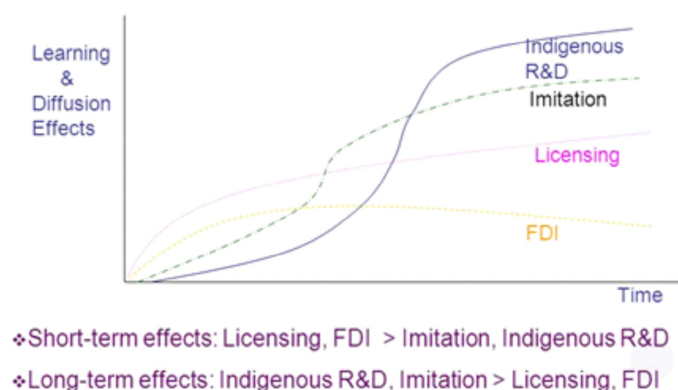


Fig 3.11: Learning and Diffusion Effects of Technology Transfer

Check Your Progress

8. What do you understand by reverse engineering?
9. How is cross-border movement of people an important channel of technology transfer?

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Imitation can be achieved with the help of reverse engineering, product inspection, decompilation of software, and trial and error. Imitation as a legal or illegal phenomenon will depend on the scope of intellectual property protection along with the security of trade secret from unfair competition as per Maskus (2000).

It is different from the earlier channels in the fact that the imitation bears no compensation to the technology owner when it comes to the formal markets. This could be seen as an attractive method attractive for learning and diffusion when seen from the viewpoint of the developing economies. But imitation can also be a costly process and could divert attention from local innovations. Thus the full accounting of the impact of imitation is complex.

3.8.2 Departure of Employees

This is one method of learning which is suited for technical and managerial personnel on whom the knowledge of a firm's technologies has been entrusted. This resource could leave the firm and join a rival firm on the basis of this knowledge. This competition could be crucial when it comes to the type of information diffusion happening in the industries and locations in which the cross-fertilization of knowledge is crucial when the employees are mobile.

In addition, technology can be transferred without formal compensation to the original owner. The process of the same would depend on the legal treatment of labour mobility, 'non-compete clauses', etc. This is done in two ways as given below:

1. Data in Patent Applications and Test Data

A method of acquiring technology without any compensation or cost is to study the available information about those technologies. The patent applications, be it registered in a country or registered abroad, could be available for this objective.

The rival firms could read such applications, and learn the underlying technologies. The firm can then develop competing processes and products which do not infringe the claims of the original applicants.

Here it can be seen that the patents provide a direct source of technology transfer, with the help of FDI and licensing, and an indirect form of technology transfer through inspection. It is being debated if the patent disclosures do give the needed information which the rival engineers can understand for the given technologies.

A related source of information could be the confidential test data which is provided by patent applicants to governments. Government agencies could choose to share this data, in a certain period of exclusivity which is generally awarded to the original applicants, to domestic rivals so that they do not research duplication costs and make the generic competition more fierce.

2. Temporary Migration

It has been seen that most of the technology has been transferred with the help of temporary migration of scientists, students, and technical personnel and faculties to the laboratories, universities, and conferences which are located in the developed economies.

In-depth training done in science and engineering could be gained in this way, which suggest that it is a long-lasting form of ITT. The main issue for the developing countries was in this context to encourage the expatriate professionals to return home

.The aim was to invite these expatriates to take up educational, local scientific, and business development.

3.9 OUTSOURCING AS AN ALTERNATIVE TO TECHNOLOGY TRANSFER

A large number of companies rely on the option of outsourcing partners for the development and manufacture of some products and their commercial supply. Some products might have a critical path and this could be a challenge for the outsourcing company.

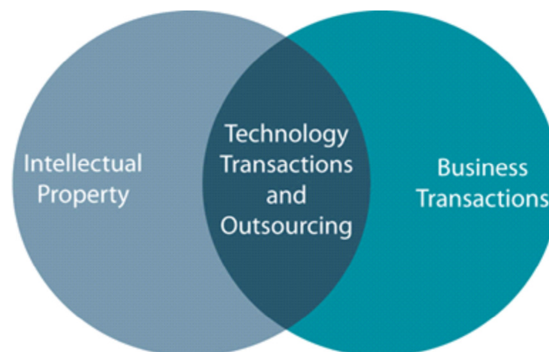


Fig 3.12: *Technology Transactions and Outsourcing*

This could be a difficult state for the Client (contract giver) and the Contract Manufacturing Organization (contract acceptor). Thus for a successful collaboration and outcome, the client expectations have to be in sync with that of the contract manufacturing organization. Therefore, there has to be a mutual understanding of risk for designing the right development and manufacturing program. Also there has to be a sense of 'co-ownership' of the project which could add in facilitating an easy contract execution and completion.

3.9.1 Technology Spillovers and Their Main Channels

One of the main issues in technology transfer is the technology spillovers and their main channels. Technology spillover can be defined as the central characteristic of technology transfer in which process of information is learned and absorbed into competition in the process in which the benefits do not fully accrue to the technology owner, original seller or the licensed acquirer.

The following aspects are needed to be taken into account. These are as follows:

- Spillover technological advantages include lower costs, follow-on innovation, greater productivity, and some other major structural elements for which the owner will not be able to charge a full value.
- This shows the market externality which the technology developers will not be able to fully recapture on the basis of social value of their inventions by the private transactions.
- These technology spillovers have to be differentiated from pecuniary spillovers that entail the shifts in prices and market structure, whose benefits cannot be extracted by the initiating party in the form of profit or rent. For example, if

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a firm that sells a homogeneous good in various markets, it might not segment those market prices to get the full surplus from each buyer. This form of spill over is the pecuniary externality through trade.

- The same could be the case when the entry of a multinational firm lessens the competition sufficiently so that the present local rival firms enjoy higher profits.
- Another example could be the counterfeiting, where the domestic entrepreneurs apply a copied trademark to their local products so as to gain profit from the mark-ups paid. This is specially done for the status goods.
- These impacts are important, and will not necessarily need a technology transfer, as they do not imply the learning of the local firms for any new information.

Channels of spillover

The main channels of spillover have been explained as below:

1. Uncompensated Imitation

The first channel of spillover is the existence of technology externalities which is the case with uncompensated imitation. This is generally done by the local competitors. The reverse engineering of a product along with the legal forms of learning trade secrets could be said to be the fair means of imitation which do bring in technology absorption. The same may be a costly process but it is a central form of technology diffusion and supports dynamic competition in the well-functioning markets.

2. Departure of Employees

The departure of technical employees to any other firm after they become experts in the technological information they were working on, from their prior employers, to a new one, could also be an important means of diffusion. These spillovers could be of two kinds: the use of the technology without improvement of prior information of produce competing goods or the adaptation of the given technology into new goods and technologies.

Trade-secrets law could restrict the former activity, for a period of time after the employee's departure date. The latter activity is but the main reason for the information diffusion and competition in industries in which the cross-fertilization of ideas and techniques has been seen to be common.

One such example is the agglomeration of information technologies which was seen in Silicon Valley in California and the Pudong area in Shanghai. These spillovers could also come into force when some employees attend conferences and training in a company's lab or through universities.

3. Information in Patent Applications

Another method of diffusion could be the engineers who study the patent applications in their own countries and abroad. This then becomes a crucial form of learning across borders. The diffusion of this sort has been prevalent in publishing patent applications where the central social benefit is awarding private exclusive rights to some specific claims.

4. Trade, FDI, and Licensing

Technology spillovers could also happen mainly due to the trade, FDI, and licensing. For example, a direct trade-related externality could arise in which the recipient firm imports a capital good and finds out that the cost of the same has been reduced by more than what was anticipated in the negotiations. Thus, there is a difference in the price of that good. There could be an indirect spillover which is present where a machine is imported with the aim of it being used in one product line. Here the importing firm could find out or learn that the same machine could be used for works pertaining to another line.

The same machine thus could be partially deployed for this purpose. The operations of MNCs could be the source of three important spillovers. One of the main sources is the movement of technical personnel.

As the MNCs arrive at a location with a superior technology it is expected that they will employ or train the local personnel. This then becomes a potential for diffusion. Uncompensated demonstration of new technologies could be another channel in which introducing the technologies within its subsidiaries could lead to diffusion of technology. There is an uncompensated demonstration effect when the local rivals adopt its best practices. This could thus be a form of reverse engineering or imitation, done at the technology level.

There are some technologies which can be easily observed, like the accounting, management, and marketing techniques and the re-organization of production lines. Some others may be difficult to understand and absorb. MNCs play an important role in this regard. The same can be concluded from the fact that it would be costly for local firms to observe and start imitating the best-practice foreign techniques. it can only be done when the local firm learn from the technologies being introduced successfully into the domestic economy through the international firms. The "demonstration" could arise from the successful use of these technologies by the MNCs. With this they could demonstrate that they are effective in the local economy.

FDI by itself is a good reason for the generation of important spillovers by the forward and backward vertical linkage effects. The forward linkage could exist when a firm produces inputs which reduce the costs of the customer firms and raises the quality of its products. Here such a linkage could also arise in a distribution sector with the norm of the MNC that products it produces or the inputs it uses have to meet minimum quality guarantees. A backward linkage could also arise when the firm's operations have an increasing demand for inputs which are being sourced from its local supplier companies.

They could decide to improve technologies and standards with the use of such companies. For the same the MNC will have to share the blueprints, which is offering know-how, for which the engineers visit plants, and study the design and technical performance of supplier products. These backward linkages could be crucial as the MNCs is expected to have higher standards for their inputs, and thus they have to share technical information with the suppliers to achieve these mandates. For the same reason, the joint ventures and licensing contracts could also offer similar channels in case of the technology spillovers which could come into a broader economy. The theory could be the same when it comes to the labour turnover, demonstration effects, and technology sharing.

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Thus, the technology transfer could generate both direct and indirect gains when it comes to productivity, product quality, cost reductions, and competition. These gains could be compensated and accrue as spillovers. Also these impacts could happen within the sectors and also across industries. Also the technology transfer could incur costs of adaptation, contracting, imitation, and absorption. The same are complex processes which command further analytical attention.

3.10 LOCAL INNOVATION IN DEVELOPING COUNTRIES AS ALTERNATIVE TO TECHNOLOGY TRANSFER

The drive of innovation may find solutions to real needs. The starting point for any innovation centre is the local area or country. In today's globalized world, these needs are rarely limited to a local context. But the local players are constantly trying to upgrade their technology and become independent from the developed world when it comes to the technology use for their progress. Innovation in technology at a local level can improve the livelihoods of any people who want a better life, and for whom technology can make a huge difference. The aim of the local innovation is the need for sustainable development, and also increasing the local capacity with the help of the use of technology. This also aims at creation of global innovation centres.

Limitation of Local Innovation

The limitations of local innovation are as follows:

- For some products, local innovation could be a problem. For example, there is a threat from counterfeit or substandard medicines. This is a huge problem when it comes to local innovation of products. This is seen more often in the developing countries, in which the use of locally produced fake and low-quality pharmaceuticals have killed more than 500,000 people a year.
- The same has also affected millions more and often brought in the situation of emergence of diseases which are resistant to the present drugs and treatments.
- These problems could further get complication if policymakers of the developing world have a wrong approach to deal with the problem. These policy makers could look for solutions abroad than having them solved with a better technology at home. This is more of a short-sightedness and a mistake which could reduce the level of innovation and progress.
- When one looks at the solutions to handling the high-impact health challenges which include the manufacturing of fake or inferior drugs, local innovations are not only a temporary solution to the problem, it could rather be a successful effort; which has the potential to provide benefits which could go far beyond the scope of the original problem.
- When it comes to the developing-country, the effort which is needed to create an ecosystem which supports the innovation might look lucrative but could fetch very little return on investment.

Check Your Progress

10. List some non-market channels of ITT.
11. What does the term 'technology spillover' mean?
12. List some channels of technology spillovers.

- Many countries do not have the resources to install, and operate equipment which might have been designed locally. This misuse and neglect might cause the equipment to malfunction. It is after this that more funds might be required for the program or else the program could simply fade away.

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Need of Ecosystem and Policy Initiatives to Promote Local Innovation

Innovation matters to least developed countries which have backward industrial conditions. The adoption of foreign technologies could have very high payoffs as the technology adoption needs an adaptation to the local technological, economic, or environmental conditions. This could lead to the development and accumulation of the innovation capabilities. It can also be seen that domestic innovation could play a bigger role in comparison to the imports of knowledge needed for the take-off of the emerging Asian economies as per Ang and Madsen, 2011.

The value of enhancing ones technology with the help of imported novelties has been long known. This notion was popularized by Gerschenkron (1962), who judged the differences in the nations' ability for developing the technology and adapting it to the particular circumstances have been the primary cause of countries' differences in per capita income. The same also makes a difference when it comes to the ability to appropriate the innovations of others which was the essence of the latecomer's advantage.

Incremental innovations in the activities beyond 'knowledge-intensive' sectors could offer substantial opportunities for success. Examples include the successful exports related to the wine from Argentina and Chile, fish from Uganda, and medicinal plants from India. It has been seen that in the initial stages, technology adoption could be done with minor innovations which could be profitable and successful as per Acemoglu, Aghion and Zilibotti 2006. It was also seen that Korea, and China's Taipei, Singapore and Hong Kong initiated with the initial stage of development which was based on technology learning. They maintained a strong focus on the building innovation capacity as they moved gradually to enhance their leading technologies.

The situation of technology innovation for middle-income economies is different. These countries have established an industrial base and have some framework conditions for innovative firms. These countries have also addressed these initial challenges for the adoption of novel technologies, but they have often face the "middle-income trap". For making further progress, these countries had a need to raise their innovation capabilities. Stress was given to innovation policies at many stages of development. The governments also engaged in a learning process for building the institutions and competences to play a crucial role in the emerging national innovation system. Here the first policy implications which could be drawn from these observations was that the innovation matters in all contexts, which include the low-income countries, and the same should be a major agendas for the developing and emerging countries.

It is also crucial to adopt a "pluralistic" view of innovation when it comes to the objectives, of content and that of processes. For the same the innovation could be extremely varied like the connection of the innovation with the level and orientation of socioeconomic development. Thus the local policies have to be adapted accordingly. Many emerging economies, especially China, are today significant actors when it comes to the global innovation system. Also one can see proof that R&D has a key role in the

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progress of the Asian economies like China, India and Korea as per Ang and Madsen, 2011.

It has also been seen that the emerging economies have industries or firms which are at the technology frontier and have the need to innovate to compete.

It is true that innovation and growth could be central in addressing social challenges, enhancing the economic performance and creating employment. However, the impacts are not socially inclusive, as the same could increase inequalities in income. The same could also increase the gap in the opportunities for the different groups in society. Many of the world's poor now live in middle-income countries in which the inequalities in income and opportunities have been skewed to a large extent. The realities of many emerging and developing countries have shown that a small fraction of the population could have a wider access to the resources and opportunities and at the same time a larger group could lack the access to the most basic resources. For many governments, the main agenda is the focus on socially inclusive development, as the high levels of inequalities could negatively affect growth.

Local Innovation Policy Agenda

Innovation policies can have an impact on the 'industrial inclusiveness', which is the extent to which a firm differs in their innovation and productivity performance. It has also been seen that many developing economies have an economic structure which is characterized by 'islands of excellence'. This means that the countries have very innovative businesses, sectors and research institutions which do coexist with a set of weak performing firms and thus have a substantial informal economy. The industrial inclusiveness could have some crucial impacts on social inclusiveness. In addition, territorial inclusiveness, which is the geographic dimensions in case of the industrial and social inequalities, could be an important facet of these inequalities.

Well-designed 'place-based' policies also aim to build one the opportunities for development which is based on the economic and social realities for different locations of a country. This could be it a capital city or could also be in a remote rural area. The same could be fulfilled by making sure that needed public goods and services are being made available to the people and firms of that local area. It can thus be seen that the inclusive development is crucial for the innovation policy agendas when it comes to the emerging countries. This has to be supported with research which is aimed at addressing social challenges.

Some of the major example show that innovative products, especially in the areas of food and health, could contribute to improving the welfare of the lower-income groups. It has been seen that the private for-profit actors and not-for-profit actors have had supported initiatives, which pertain to the financial aids and other related aids. Thus to serve lower-income markets, the demand-side characteristics have to be modified beyond the high sensitivity to price. This demand-side characteristics has to be adjusted for the products to be usable for the specific user.

The lack of access to basic amenities like electricity, and the issues of providing information about the product purpose and use, could show low human capital for most of the low-income groups.

Check Your Progress

13. Enumerate the role of local innovation in technology transfer.
14. List the limitations of local innovation vis-a-vis international technology transfer.

3.11 SUMMARY

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Some of the important concepts discussed in this unit are:

- The process of transferring technology from places of its origin to wider distribution among more people and places is known as technology transfer. It occurs along various levels: from large businesses to smaller ones, across borders, both formally and informally.
- A lot of technology transfer is implicit when it comes to the international trade in goods and services and factors, and it becomes difficult to judge the proportion of prices or flows which have been reflecting in the technology content.
- The information-transfer process could be said to be one of the most critical steps for technology transfer. The new licensing practices are designed to address this method. For example, many licenses could bundle the basic technology and the equipment which one needs to use for the technology when it comes to a single agreement.
- Licensing and franchise arrangements could be different for different technical assistance, package of instructions, and training, or a mere permission for the manufacture or sale of a product.
- Developing countries have made a good technological progress but the technology gap between the developed and developing countries has been wide. Here the role of FDI with the help of the transnational corporations (TNCs) has been crucial in narrowing this gap.
- The transfer of technology by multinational corporations (MNCs) is crucial in developing countries. This will be crucial for sustainable development and improve the quality of life. Technological transfer through the MNCs is a two-way relationship where it involves the technology between and among firms, industries and governments.
- Reverse engineering could be applied for retrieving constituting elements of a product. This is done when there is a lack of access to the primary design and the same could be used for development, maintenance, and extension of the existing possibilities and re-engineering.
- One of the significant channel of technology transfer is the cross-border movement of technical and managerial personnel. Sometimes, new technologies cannot be afforded and they do not get transferred without services of the engineers and technicians who have to be on-site for a certain period of time.
- It has been seen that most of the technology has been transferred with the help of temporary migration of scientists, students, and technical personnel and faculties to the laboratories, universities, and conferences which are located in the developed economies.
- The drive of innovation can find solutions to real needs. The starting point for any innovation centre is the local area or country. In today's globalized world, these needs are rarely limited to a local context. But the local players are constantly trying to upgrade their technology and become independent from the developed world when it comes to the technology use for their progress.

3.12 ANSWERS TO 'CHECK YOUR PROGRESS'

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1. Varieties of technology transfer are: (i) International Technology Transfer, (ii) North-South Technology Transfer, (iii) Private Technology Transfer and (iv) Public-Private Technology Transfer.
2. There are five information activities which have to be supportive for the technology transfer. These are:
   i. Technology Scouting
   ii. Technology Marketing
   iii. Technology Assessment
   iv. Transfer-related Activities
   v. Finding Experts
3. Two major types of technology transfer methods: Market mediated and non-market technology transfer.
4. The principal routes of technology transfer are:
   i. Licensing
   ii. Supplier of materials and parts
   iii. Equipment Supplier
   iv. Outright purchases
   v. Acquisition
   vi. Joint Ventures
   vii. Franchising
   viii. FDI, MOU and MNC
5. Transfer capability of the organization which is supplying the industrial technology could have an important impact on the effectiveness of the technology transfer. The competence of the transfer agents, which includes the ability to design an easily transferable technology package, can also be a crucial factor.
6. The various channels for trade are: Trade in goods, Foreign Direct Investment, Licensing, movement of people
7. FDI provides the developing countries with efficient foreign technologies which result in technological spillovers and greater competition.
8. Reverse engineering is said to be the process of discovering the technological principles of a human or non-human made device, object or system with the help of the analysis of its structure, function and operation.
9. One of the significant channels of technology transfer is the cross-border movement of technical and managerial personnel. Sometimes, new technologies cannot be afforded and they do not get transferred without services of the engineers and technicians who have to be on-site for a certain period of time.
10. Some non-market channels of ITT are: Imitation and departure of employees.
11. Technology spillover can be defined as the central characteristic of technology transfer in which process of information is learned and absorbed into competition in process in which the benefits do not fully accrue to the technology owner, original seller or the licensed acquirer.

12. The main channels of spillover: 1.) Uncompensated Imitation, 2.) Departure of Employees, 3.) Trade, FDI, and Licensing
13. The drive of innovation can find solutions to real needs. The starting point for any innovation centre is the local area or country. In today's globalized world, these needs are rarely limited to a local context.
14. Some limitations of local innovation vis-a-vis international technology transfer are:
    i. For some products, local innovation could be a problem. For example, there is a threat from counterfeit or substandard medicines.
    ii. When it comes to the developing-country, the effort which is needed to create an ecosystem which supports the innovation might look lucrative but could fetch very little return on investment.
    iii. Many countries do not have the resources to install, and operate equipment which might have been designed locally.

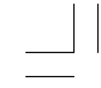
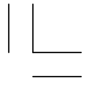
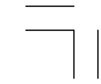
3.13 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write in brief about technology transfer and its scope.
2. List some information activities which are needed for technology transfer.
3. Write a short-note on technology transfer modes.
4. Discuss the significance of FDI for developing countries for accessing foreign technologies.
5. Discuss the role played by non-market channels in international technology transfer.
6. Write a short-note about the need of support to local innovation especially in developing countries.

Long-Answer Questions

1. Enumerate the various types of technology transfer.
2. Discuss the contractual and non-contractual modes of technology transfer.
3. Write on the various strategies widely used for technology transfer.
4. Discuss the role played by TNCs in transferring and diffusing technologies that finally reach out to a wider range
5. When it comes to developing countries, licensing plays a crucial role in technology transfer. Elaborate this statement with examples.
6. Explain 'technology spillover' and discuss its advantages and disadvantages in technology transfer.
7. Discuss how local innovation in developing countries like India can become an alternative to technology transfer from industrialized nations.


UNIT 4 CONCEPT AND NATURE OF TECHNOLOGY ABSORPTION

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Structure

4.0 INTRODUCTION

There are several pioneering studies on technology absorption. However, one may agree on the proposition that technology absorption in terms of the ability to understand, deploy and improve upon technology is essential for industrial development. The term 'technology absorption' is defined as a process in which series of technologies are modified or altered to be absorbed while keeping the needs of the buyers in mind.

The term 'technology' is understood in a broader concept as a set of information or knowledge, which is used for producing specific goods or services. The capability of absorbing such 'technology' contains various aspects of capabilities like adoption, adaptation and optimization. Then there is the capability of assimilating the adopted technologies through 'learning by doing' (assimilation capability). These form the core of technology absorption and are necessary and sufficient conditions for improving productivity and quality of products. There are external and internal factors which could affect the technology absorption capability. So, the notion of 'technology absorption' is not a static concept, but a dynamic concept. It is designed to incorporate the speed of introducing new technologies and the degree of assimilating these technologies.

The roles and functions of human resources involved in technology absorption may be different at the stage of adopting technology from the stage of assimilating technology. The question of what causes technology absorption higher or lower mainly depends on many factors like market forces, the government policy, etc. This unit aims at understanding the way in which technology absorption is viewed and brings out a conceptual framework of technology absorption.

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4.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Discuss technology absorption and its capabilities
- Describe the cycle of technological absorption -- transfer, adoption, adaptation, and assimilation
- Understand absorption and productivity
- Explain technology absorption and human interactions
- Enumerate the stages of technological absorption
- Learn about psychological factors influencing technological absorption
- Discuss organizational redesign and re-engineering

4.2 UNDERSTANDING TECHNOLOGY ABSORPTION, ITS CONCEPT, NATURE AND CAPABILITIES

Technology absorption is a process in which the various features of the technology that are the subject of transfer could be reasonably modified or altered with the needs of the buyer in mind. It is crucial to understand the concept of technology absorption.

4.2.1 Factors Affecting Technology Absorption

The factors that affect technology absorption are as follows:

- There are many factors, including external and internal factors of a company, which could affect technology absorption capabilities. External factors are related to the type and proximity of the external technological knowledge which is to be acquired. It is also dependent on the availability of finance.
- At the same time, technology absorption depends on some internal factors which include the internal factors related to the companies' internal capabilities that could help them to absorb new technology and its knowledge.
- It is these internal capabilities that could get affected by external factors. Thus, external factors will be studied in relation to their effects on the internal capabilities pertaining to the technology absorption.
- There exists a relationship between the factors effecting technology absorption which include company performance as well. There is a relationship between the two factors, namely technology absorption, and company performance.
- Coming to the external factor, it includes the type of technology knowledge to be absorbed, the source from which it is acquired, and method in which it is transmitted. These all factors affect the outside knowledge of the technology.

Apart from these knowledge-related determinants, there has to be the availability of capital which becomes a significant factor in the acquisition of external funds so as to develop internal capabilities.

4.2.2 Knowledge Type

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Some aspects of knowledge type are as follows:

- The characteristics of the external knowledge which is to be absorbed could be the basic external parameters which affect the companies in absorbing the technology. Some similarities do exist between the internal knowledge-base of the company along with the external knowledge playing a vital key role as per Cohen and Levinthal, 1990.
- Also the company's knowledge absorption capabilities could be closely related to the type of the outside technology which is being transferred.
- Knowledge type could depend on the factors like maturity of technology, area, sector, level of expertise, and the knowledge source.
- It could thus be said that the R&D knowledge which is produced by a pharmaceutical company could be of the basic nature, but that of the automotive company could be of an applied nature. For example, in an automotive production system, the same might include a certain amount of tacit knowledge, which is needed while designing a car with new technology. This could be highly codified. This being a sector of expertise, and a high technology level, two companies could differ to a very large extent to the capabilities of codifying knowledge that can be absorbed by other companies.
- Thus the knowledge of the technology could be existent in two dimensions namely nature and form as per Mangematin and Nesta, 1999. The nature of the knowledge could be related with its content, in which the form relates to how the same is presented.

Knowledge could be of two natures, one being fundamental and the other applied. These two forms, tacit or codified, have been discussed in the following sections.

1. **Fundamental Knowledge**
   - Fundamental knowledge could be a type of knowledge which is used in basic research activities or could be produced as a product from basic research. According to the Organization for Economic Co-operation and Development (OECD), basic research includes the theoretical or experimental activities, with a primary goal is to learn the underlying foundations of phenomena. But there is no intention of any specific application or use of that technology.
   - Some other studies like the one made by Cohen and Levinthal (1990) have made a distinction among the knowledge which is related to basic research and the one which is related to the applied research.
   - The research proves that the former is less targeted as compared to the latter. Basic research could be carried out by universities and not companies. Moreover, some big companies could be involved in basic research along with a collaboration with the universities.
   - Basic research produces knowledge which can be utilized by the units which are carrying out applied research as per Henard and McFadyen, 2005. Thus, the companies would need to absorb the knowledge and technology which is produced by basic research so as to use it in the applied method in



Fundamental knowledge: It is a type of knowledge which is used in basic research activities or could be produced as a product from basic research.

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their companies. The companies could also go into an applied research with the universities.

2. **Applied Knowledge**
   - Applied knowledge about the technology could be acquired from applied research. The OECD defines applied research as the original investigation undertaken in order to acquire new knowledge. This is but directed primarily towards a specific practical aim.
   - Companies can make use of the applied research by themselves or with the collaboration of universities. Applied knowledge can become an output of applied research and can be used to absorb technology related to the designing new products and modify existing technologies.
   - The knowledge acquisition for technology absorption is somewhat related with the capabilities of design units of the company which is acquiring this technical knowledge.
   - Applied knowledge about the technology can be received from the companies which become an output of design activities that could be used for manufacturing products. Here, the company's manufacturing capabilities could gain importance so as to make use of the external design knowledge.
3. **Codified Knowledge**
   - Codified knowledge can also be obtained for technology absorption by transforming knowledge into formal structure so that the same could be better circulated as per Mangematin and Nesta, 1999.
   - This codification is not an easy task and this knowledge about the technology might not be fully codified as per Saviotti, 1998. Some other studies show that assimilation and exploitation of the codified knowledge would need prior knowledge. Although the company acquires the knowledge only after the acquisition of technology.
   - The same is done by the personal interactions so as to interpret the knowledge about the technology correctly. This could lead to a better absorption of technology by the companies about to use it.
   - The knowledge source focuses on some parts of transfer purposes, and the same has subsidiary awareness regarding some other parts. Some other studies like the one made by Howells, 1996, show that non-codified part of the knowledge is known as tacit knowledge that could be circulated by informal ways .
   - Tacit knowledge could complement codified knowledge and will not just substitute it as per Cowan and Foray, 1997. It is because the people having tacit knowledge about a new technology cannot express it in a written formal structure. The transmission of the same during technology absorption will depend on interpersonal contacts as per Hicks, 1995.
   - Moreover, when it comes to such contacts, researchers like Mangematin and Nesta (1999) have highlighted the effect of exchanging scientists among the research units for better technology absorption.
   - According to Howells, tacit knowledge could also be related to learned behavior and practices which pertain to the technology absorption.

- It can be said that the research findings in a new area can be said to be tacit and not codified as there is lack of familiarity to formalize that technology-based knowledge. In addition, one could say that the production method could have important tacit elements as the philosophy behind some specific applications has not been formalized.

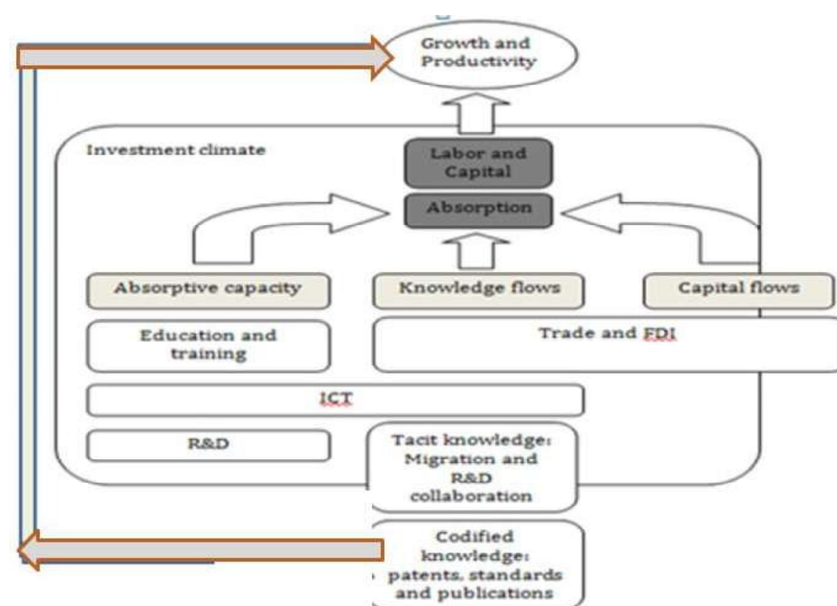


Fig 4.1: *Codified Knowledge Enhances Growth and Productivity*

4. **Knowledge Proximity**
   - Interpersonal contacts could be of significant importance when it comes to the transmission of all knowledge types which are needed for an effective technology absorption. This is also the case when one speaks of tacit knowledge.
   - One could list five types of knowledge proximity which include social, organizational, geographical, institutional, and cognitive. Social proximity shows the level of personal contacts which exit among the people sharing the technology.
   - The technology absorption needs the accompanying personal interactions which are very important when it comes to the fundamental nature and a tacit form of the same.
   - Social proximity can be a crucial factor when it comes to achieving social interactions. These personal contacts could be present in the following forms:
   - Direct relationships which include the classmates, family, and work colleagues could also affect the absorption of technology.
   - The indirect relationships like the members of the same networks could help in an enhanced technology absorption in a company.
   - Technology absorption and its credibility will also depend on the reputation of the universities and companies from which the technology has been received. The cultural cues which could be having a common ethnicity, nation, and culture could also help in a better technology absorptions among the colleagues.

- Thus, it has been proven that the personal interactions among the people who come from different organizations could also create trust and reciprocation. This trust and reciprocation could allow the correct and complete transfer of knowledge which occurs among the people reciprocally.
- Moreover, social proximity could also decrease the chance of misinterpreting, as there is a frequent face-to-face communications while absorbing and learning about the technology in an organizations. It has also been seen that the social proximity could help overcome the conflicts which are caused by geographical proximity with the help of social networks. The organizational proximity will depend on the structural relationships which exist among the organizations. Organizations could be communicating among each other and could be the units of the same company.
- Thus, the members of the companies of an industrial firm or a network of companies could be united in adapting to a new technology as per Kirat and Lung, 1999. The factor of organizational proximity will increase with the strength of these relationships.
- The highest organizational proximity could be seen in a hierarchically organized company and the lowest could be in a flexible company, network, or joint-venture.
- Another factor crucial for the technological proximity is the institutional proximity which can be defined by the formal and informal norms which could determine the relations along with the communications between institutions as per North, 1990.
- These communication norms and rules have been available and the senders of the technology have to assure the quality and credibility of the communications as the information level of the sender of the technology could be superior to the receivers.
- Also the absorption of the technology could depend on the cognitive proximity which refers to the level of similarity which exists between the senders and the receivers when it comes to the cognitive dimension. This will increase the level of knowledge of the receivers, so as to identify quality problems for the information received as per Wink, 2010.
- Another factor which could affect the absorption of technology could be the capital needs. The companies need capital for funding the payments made to the organization from which the technology is acquired from. Also one might have to train the employees and this might be an additional cost.

4.2.3 Technology Absorption Terminology

1. **Adoption:** Technology adoption is a process in which the various features of the technology that are the subject of transfer could be reasonably modified or altered with the needs of the buyer in mind. Thus, it can be said that the needs of the buyer of technology would get crystallized and the supplier could make suitable modifications to the technology, which is being supplied to the buyer so that it conforms to the requirements of the buyer as much as possible.
2. **Adaptation:** Technology adaptation is a phase which will take place after the technology has been adopted. The same will only take place when the production

activities and facilities have already started using the technology. In this stage, there are a number of alterations which can be done to suit the indigenous conditions and the same could relate to the usage of raw materials and components manufactured. This covers the product modifications along with the production technology changes, when one is using the indigenous skills along with the local materials.

3. **Absorption:** This would include the 'Know-why' exercises, which are the basic investigations of the product, process or the systems. The same would require to unpack the aging of a technology package. This also needs the R&D projects in knowing the optimization and improvement of product, process, systems and other related equipment.
4. **Optimization:** This can be termed as the effective savings for the use of material and energy consumption present both in the product and processes that constitute optimization of technology.

4.2.4 Stages in Technology Absorption

The major stages in the technology absorption are as follows:

1. **Project Formulation**
   i. Preparing a pre-feasibility report
   ii. Negotiations on the technology
   iii. Approvals from the local and foreign Government
   iv. Collaborating with the foreign agencies
   v. Budgeting from financial institutions
   vi. Acquisition of land
   vii. Getting clearances from State Govt. and other formal bodies related to technology absorption process
2. **Project Execution**
   i. Technology transfer process
   ii. The designing and know-how of the technology through experts and training
   iii. The using of Indian consultants
   iv. The procurement of components, equipment and materials
   v. Technology payments and payment for equipment
   v. Implementation of the project
3. **Technology Adaptation**
   i. The trial runs of the technology have to be done
   ii. Debottlenecking of the technology or the rectifications have to be done.
   iii. Production which is based on the selective imports of components or RM will be done
   iv. Indigenization of the RM, components and equipment will be done
   v. Adjustment of the product and process technology to suit local conditions will be done.
4. **Technology Absorption**
   i. Analyzing and unpacking of the technology is done

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ii. Investigation of the product and the process designs as is related to the technology will be done

iii. Optimization of the technology for better quality and performance will be done

iv. Designing and developing of components, raw materials and equipment will be done

v. One could use research linkages for better absorption of the technology.

5. **Technology Improvement and Upgradation**

   The process of technology improvement and upgradation is very crucial for any technology absorption. One could improve the product and process designs and technology so as to get a better performance or utilization from that technology. In addition, one might have to use the appropriate research linkages for the effective absorption of the technology. The next step would be to upgrade the product or process so that one could reach larger scales and capabilities.

4.2.5 Benefits of Technology Absorption

There are many benefits of technology absorption. Some of the major benefits have been listed here. These are as follows:

- One of the major advantage of technology absorption is that repeated collaborations for the same product or process can be avoided.
- Another benefit is that acquisition of future technologies can become selective. Yet another benefit of technology transfer is that the ability of unpackaged technology can be enhanced.
- As a result of technology absorption, exports start increasing. Moreover, the knowhow and technology upgradation capabilities can be better built up.
- Technically competent groups which include scientists and engineers can get trained in technology absorption and thus become matured and strengthened for that particular technology.
- The base for technological self-reliance gets enhanced. The product and process cost saving can be done through the process of technology absorption. Technology absorption can also increase the sales and profits.

The Future Process of Technology Absorption:

- Industry has to attempt to obtain the best available technology which is closest to international trends.
- Industry should also cater to R&D pertaining to the stage of project planning. Another need here is the speedy indigenization of raw materials along with the new technology components.
- There is a need for efforts to be made for unpacking the aging of tailor-made equipment which pertain to the acquired technology.

Technological Absorption in Indian Industry

Technology absorption can be implemented differently in different countries. The same is the case in India. Governments have to have their own technology policy that pertains

to absorption, acquisition and adaptation, which could happen on a long-term and short-term basis. The Indian government should consider travel grants along with incentives so that companies can participate in international seminars and symposiums. In addition, Indian companies could be given training abroad so that they are updated with the latest development in their fields.

In technology absorption, the R&D personnel who come from the in-house or national laboratories should be involved closely in the transfer of technology. This involvement should be present from the conceptual stage itself. Incentives should be given for the prototype development along with the testing facilities, pilot studies, etc. for the adaptation, absorption and up gradation of the imported technologies.

International R&D collaborations should be increased and encouraged. The information of the acquisition of foreign technologies has to be widely disseminated for making R&D personnel aware to the new needs of the industry. This could enable the personnel to formulate the programs accordingly. Also tax benefits could be considered for investments which help in the technology absorption and up gradation of the present processes and products. The information base should be set up for the modern available technologies at an international level.

Fast technologies like electronics and foreign collaboration agreements should pertain for short durations. It is also true that the standards for various components, products, and materials have to be revised and updated .This has to be done on a continuous basis especially for the industries like automobiles.

Moreover, a complete documentation for all the national research facilities have to be compiled when it comes to the activities and developments which are carried out by them. There has to be periodical review meetings which pertain to the R&D chiefs of the respective industrial units so as to discuss the technology absorption efforts which could be organized. Also the incentives have to be given to firms which adhere and follow the phased manufacturing programmed as per the specification of the collaboration agreement. In addition, time-bound programs for the absorption of imported technology has to be planned and initiated by the company with a collaboration agreement. The involvement of experienced and expert R&D personnel during the negotiations and acquisition and absorption of technology is necessary.

The user's support in the development and utilization of absorbed and upgraded product and technology is crucial. One also has to set up the research advisory committees which could be done by major companies, importing complex technologies. One may also need the support of the government for catalyzing the above efforts of the industry so that one could ensure an effective and complete absorption of imported technology.

Technology Absorption and Its Implementation

It has been seen that over a period of time, the term technology absorption has become very popular. The following steps are required for its implementation:

- Co-development and co-production is a precursor for technology induction and absorption in any country. Joint development programs, where there is access to technology which individually the partnering companies or countries have not been able to develop, could be realized at a less cost and time.

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- Co-development and co-production is a process in which companies or countries can act as partners for some specific contribution to technology. This can lead to some financial benefits which are connected to the contribution and the primary benefit in this case would be the access to advanced technology for both the parties.
- Also the same could provide the Indian vendors with the needed skill sets with the help of the contribution of the foreign party in the joint program.
- Joint Intellectual Property rights along with the international market space could be a component of the negotiated contract. Thus, the same can provide international exposure and can also give a share of the resultant revenues to Indian firms.
- Another method of technology absorption can be sub-contracting and contract manufacturing. This could occur when the foreign vendor gets some technology- related components and subsystems for export from industries in countries in which the vendor has to meet offset obligations. The sub-contracting or contract manufacturing can be an effective mechanism in bringing the technology.

4.3 CYCLE OF TECHNOLOGY ABSORPTION

The technology absorption lifecycle can be described as a sociological model which describes the adoption of a new technology or innovation, as per the demographic and psychological characteristics of a given groups of adopters. This describes the process of technology adoption over a period of time which is illustrated as a normal distribution or a 'bell shaped curve'. According to this cycle of technology absorption, the first group of people who use the new product are generally called the 'innovators'. The innovators are followed by the 'early adopters'. Next in the line are the early majority and late majority, and the last group which adopts to the newer technology are labelled the 'laggards'.

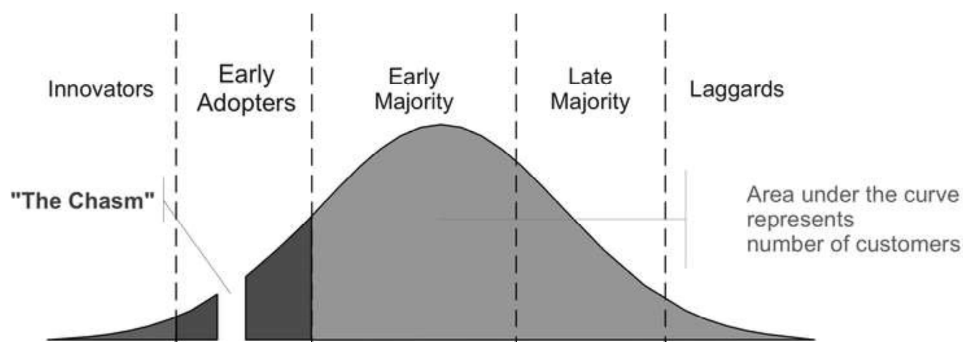


Fig 4.2: *Technology Adoption Lifecycle*

The demographic and psychological profiles of every adoption group have been listed by the North Central Rural Sociology Committee, which is a subcommittee for the Study of the Diffusion of Farm Practices by agricultural researchers Beal and Bohlen in 1957.

Check Your Progress

1. What do you understand by technology absorption?
2. Name the two important factors that impact technology absorption capability.
3. What are the two forms of knowledge?
4. What do you mean by codified knowledge?
5. List the major stages in the technology absorption.

4.3.1 Transfer, Adoption, Adaptation, Absorption and Assimilation

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Technology absorption refers to the acquisition, development, assimilation, and utilization of technological knowledge and capability by a firm from an external source. The transaction occurs between transferring and receiving organizations. This would mean that the acquired technology will be further developed, assimilated & utilized. The major dimensions of technology absorption can be summarized as follows:

1. Absorption of information about the equipment, physical phenomena, machines, operating techniques, etc., of the new technology.
2. Understanding the attitudes, feelings, etc., which are needed between two parties for becoming successful in the know-how of the technology from one to another.

It is true that the need, and desires of man led to the invention of technologies. Technologies have made life simple and work easier. For example, the development of cell phones and the Internet has brought about enormous improvements in personal and work life. These improvements in technology are now happening at a rapid phase. However, the use of these technologies is, however, far lower than their capacity.

It can be said that technology improvements that have happened through technology development and technology adaptation are crucial to the development of any nation. When one takes the customer point of view, one can say that technological development has happened. These technological developments include the new design of machinery, new equipment, new production processes, new and innovation materials and methods of production. Along with the development of technology, consumers have to adopt and adapt to these developed technology for fulfilling their needs. The same could be achieved by some specific marketing strategies that would cater to the local tastes and preferences. This process of catering to the target customers is called technology adaptation.

For the better understanding of the process of adoption and adaptation of any technology some more processes need to be explained.

Companies have to understand the community better and provide an appropriate technology and a suitable strategy which could lead to success and sustainability. The authors Zahra and George (2002) subdivide the process of technology absorption into four steps.

1. The first step as per the authors is the acquisition that relates to the ability to acquire external knowledge crucial to the company's operations. Here the intensity, direction and the speed of the activities undertaken by the employee could be the critical elements.
2. The second stage is the assimilation, which is related to the stages of analysis, and interpretation of this new external knowledge or technology obtained.
3. The third step would be the transformation, which is the firm's ability to develop the company's routines, so that this new technology or knowledge could be synched with the existing knowledge.
4. The last and fourth stage is the exploitation of that knowledge which could be done by integrating it to the structured routines, and by enabling the firm to sustain the benefits related to the new technology which it has assimilated and transformed, over a long period of time.

Here are some important takeaways from technology adoption and adaptation:

1. There are many sub-activities that which lead to adoption and adaptation of the technology. There are also many factors which could determine adoption and adaptation approach in the process of technology adoption. The structure is a basis for further refinement and a detailed research into every factor should be done for determining people's approach to every technology.
2. Technology adoption might not need technical requirements but could be related to the cultural preferences in the process of technology adoption. For example, there are different methods of bloom smelting used by different people. This suggests that smelting technology is determined by cultural preferences as opposed to technical requirements. This shows the beliefs about technology which could have not been discovered by other ways. The given preferences or beliefs could be expressed in choices which persist among the given technical alternatives pertaining to design of the bloom smelting process and the actions which are social rather than a result of metallurgical consequences.
3. Technology adoptions and adaptations have been prevalent due to the competitive pressure that is being exercised by entrepreneurs. The pressure is of using alternative methods or techniques along with the free exchange of information for elite society.
4. It has been seen in many cases that technology is adopted but the same is not adapted. This is because of a lack of information pertaining to the technology, lack of availability of land and lack of any advantage perceived over the traditional technology which is present in the country.
5. In case the technology is not market-driven, and there is no clear separation among the economics and culture and belief, then adaptation of technology could become impossible in many situations. For example, one could see the case of Bloomers in Africa. They did not adapt to the new technology. This was because of their culture driven approach. At the same time, the North Atlantic population was market-driven. Thus, it can be understood that one has to consider the social economic factors pertaining to a country and the technology absorption in the same. The negligence of socio-economic factors could lead to inappropriate targeting of technology to areas where there is a lesser likelihood of adoption.
6. It can be said that the technology adoption to adaptation stage needs constant political commitment, technology transfer and innovation, financing, monitoring, etc. Also, it is crucial to understand that the user's decision on adoption process would start from the initial adoption to technology adaptation is very crucial for the successful adoption of the technology. For example, when we come to the alley farming technology, its absorption is very slow.
7. This was because of socio-economic reasons. Farmers experimented with different configuration of technology for its adaptation. Thus, the adaptation of technology like solar stills could help to solve some of the major socio-economic problems. Another example could be the availability of water. This could have a multiplier effects like a better social mobilization, women empowerment, etc., according to UN-Habitat, 2006.

8. There are other aspects related to the technology adoption like 'emotional marketing' of the products. The attractiveness of the products along with the positive market strategy having a novel idea for the product, could lead consumers to form an emotional bond with the product. This emotional bond is the feel good factors of the consumers when he or she uses the products. For example, when one takes the example of herbal soaps which have a different fragrance, one can depict the same being used by great saints of the country. The same is thus related to saintly emotions. Also, the same could have many medical benefits which one could obtain by using the soap. This could increase of the products' lifespan. This is because the users could use the product for a longer period of time. Thus, attractive products which have a high aesthetic quality could arouse attention of the population which might use it. It is therefore easier to learn and produce more harmonious results for the new technology. When one is progressing towards a new technology intensive development, it is needed to evolve and develop the product on the principle of need base. Thus, if the company wants the product to be adopted by the nation in which it is selling the product, then the company should be able to adapt the product so that it becomes locally appropriate. Also the company should be able to mould the technology in such a way that the technology could be given some real time targeted solutions that are sustainable and replicable.
9. In addition, the behavioural intent of the consumers to adopt and adapt to the new innovative technology is also crucial. The same becomes more important when the adoption is to be done as per the configuration of local situations. This will also ensure that an appropriate technology is being provided. For the same, an appropriate strategy has to be formulated in case the company wants the new technology to sustain.
10. It is also crucial to know what the final user thinks about the innovation of technology. Initially, there might be problems in adapting to the technology. This is because a consumer might already be using an old technology and is thus using the same technology. Also working with an old equipment, technology, process, etc., is easier and thus neither the company nor the consumer wants to adopt a technology which has been transferred from another firm. Moreover, the adoption of the technology would need proper training about the technology, its equipment and the processes pertaining to them. This could only be done when the user is aware and has knowledge and understands how to use the technology to get its best efficiency.

4.4 ABSORPTION AND HUMAN NTERACTIONS, PSYCHOLOGICAL FACTORS, ORGANIZATIONAL REDESIGN AND RE-ENGINEERING

According to the author and scholar Giovanni Dosi, innovations and new technology can be said to be generated by a combination of new knowledge. He characterized the technology absorption as reflecting the search for a solution to the problem which could require the knowledge derived from past experiences, and the same could require some formalized knowledge like the one generated by the natural sciences.

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Emotional marketing: It refers to the practice of building brands that appeal directly to a consumer's emotional state, needs and aspirations.

Check Your Progress

6. What is the lifecycle of technology absorption?
7. What is the first step in the process of technology absorption?

It has been seen that the learning processes which come up from the search pertain to the use of the sources of information and knowledge. This usage could be internal or external as far as the firms are concerned. There is a set of cost involved when technology is transferred and absorbed. Thus, firms generally participate in the innovation search in case they perceive the profit opportunities which have not yet been exploited. Therefore, one has to be in a position to foresee and exploit technological opportunities. This pertains to the way the country absorbs the technology. The same depends on the level of accumulation of relevant knowledge.

Dosi states that research stresses mainly on the R&D. The processes of searching and adopting new products can be defined by the combination of various elements, which include the training and the stimulus which is generated inside each firm and every industry, the technology situation in different sectors, the consumption pattern of the population, competition pattern of the industry, macroeconomic trends, the financial structure, public policies, etc. It is true that the relevance of these factors is crucial. It would thus be impossible to consider them together and do an analysis. A lot of research has been done on the role of suppliers, competitors, customers, universities and research centres when it comes to the technology absorption.

Here the concept of innovation could be seen as an interactive process which arises from internal and external learning. There is also a reference of sectoral factors in technology absorption when it comes to the research done by Breschi and Malerba, 1997; Malerba, 2002. Also there are regional factors studied by Cooke and Morgan, 1998 and the local factors studied by Cassiolato and Lastres, 2003. The dual effect could be prevalent when it comes to the generating of knowledge which is directly applicable to the new products and processes. The same could also increase the ability to understand and absorb the technology and knowledge which is generated by the external technology partners. This absorption of knowledge and technology includes getting knowledge from universities, suppliers, research centres, and customers.

There are empirical studies which stress the expansion of the absorption capacity and many researchers have published notes which stress the diverse ways which can be used to absorb knowledge and technology which is generated from outside the firm's perimeter.

According to the researchers Cohen and Levinthal (1990) the characteristics of the labour force which is employed, the company's manufacturing routines and the experience which one gets from the productive activities, are the main factors which effect the absorption capacity. Each firm's absorption capacity is built on a process that depends on past decisions which is known as the path dependence. Also the absorption capacity could be broken into several stages that surely need considerable work.

Thus, one can say that it is not possible to increase the absorption capacity of a nation solely by learning. The same has to be enhanced by doing tasks, as has been explained by Arrow (1962). Also authors like Mowery, Oxley and Silverman (1996) have argued that the technology absorption capacity will pertain to the comprehensive set of skills needed to deal with the tacit component of the knowledge which is to be transferred from the external sources. This will also need the ability to modify itself. There is a complexity attached to the tacit knowledge transfer which reinforces the

idea that knowledge acquisition needs a counter effort to get a hold of the relevant events that have been occurring beyond the firm's boundaries.

Thus, the concept of absorption capacity refers to the complementarity of internal and external knowledge that are involved in the innovation process. It is expressed in the firm's ability to learn from the external environment. This could develop the firm's own experiences that have been accumulated in the company's production and innovation routines. As per Mowery, Oxley and Silverman (1996), the importance of the same can be summarized as the understanding which brings in an effective participation or interactions that could positively affect the absorption capacity. Thus, the development of skills in a particular area can give the firm an added advantage in absorbing new knowledge for this. This is a privilege that is crucial in times of uncertainty. This is because this factor is related to the company's ability to judge the commercial potential of new production and technological decisions. This concept is broad and complex, and is not a characteristic which can be measured quantitatively. This explains the lesser number of empirical studies which have been published on this topic.

There is also a large proportion of analysis which has been done on the subject as per the research of Stock, Greis and Fischer (2001). They have stressed the need for in-house R&D to effectively absorb the new technology. Also many successive endeavours used to diversify ways for quantifying the phenomenon have also been seen among the latest studies which pertain to the economics of innovation and technology.

There are many variables which relate to the training activities, quality of the workforce, and entrepreneurial attitudes that have been found to be important and can be widely-emphasized in the use of in-house R& D. The same is evident in the research which pertains to Murovec and Prodan, 2009; Schmidt, 2005; Arbussa and Coenders, 2007; Tsai, 2009.

In some studies in Brazil, like the one done by De Negri (2006), there are some key references made towards the factors affecting technology absorption. On the basis of Schmidt (2005), there is an emphasis on the use of external information sources when it comes to technology absorption. This research investigates how external information that pertains to related R&D activities and also relates to the characteristics of the labour force had been employed in the Brazilian firms, and how it affects the technology absorption. The analysis talks of the external information sources divided into two categories, which are business and academic. The results show the profile of the workforce and as per Caloghirou, Kastelli and Tsakanikas (2004). The same does effect the technology absorption levels. One can also find evidence from the findings of Laurensen and Salter (2006) that show a substitution effect among the search for the new external technology and in-house R&D activities.

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Absorption capacity: It refers to a company's ability to learn from the external environment.

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Fig 4.3: *From Researching Product to Receiving Royalty*

When one considers the cost of searching outside the firm, stress is placed on the fact that, at a given level of expenditure, the increase in expenses will have a negative effect on innovative performance. The theoretical potential benefits of the variety of knowledge which are related to the diversity of sources, and the degree of openness have to be weighed against the costs of such openness. R& D activities could be related to absorption capacity, and could stress on the effectiveness of the company's training initiatives. This could further depend on the ability to retain the employees who have been trained for the new technology.

Absorption capacity and the formation of a new technology or knowledge could come from in-house R&D too as per Cohen and Levinthal (1990). This offers a key perspective for evaluating the R&D absorption capacity which can be noted when one finds out the firm's ability to exploit the external knowledge. This could be a by-product of the company's in-house R&D activities. The same could stimulate the firm's core technological capacities, and thus enable in the better understanding of the tacit knowledge which is embedded in processes and products. This could further enhance the company's ability to absorb external technology. The thinking that high value to R&D in a company could connect it to the external knowledge sources has been found to be evident in many studies like the ones done by Freeman, 1991 and Chesbrough and Teece, 1996. Thus, there is also importance given to the investment in R&D which is crucial for generating knowledge that can be applied directly to new products along with the new processes, and could be recognized to a greater or lesser extent in all studies pertaining to innovation.

Absorption capacity can be enhanced by training and education. Training is recognized as a crucial element when it comes to the innovation capacity pertaining to the region or country as per Lundvall et al, 2002. Also, when we see the same at the firm level, the training activities have to be viewed as initiatives which are needed for the transfer of technology from a person who is specialized in the know-how of the same to someone who has not developed a specific routine, and does not have knowledge about this technology.

This can be an initiative which transmits tacit knowledge. The benefit that arises from the increase in the firm's capacity can also lead to the discovery of problems which might come up in production routines. Quantification of this element frequently demonstrates the importance attributed to the qualified personnel who are present in the firm.

In addition, Murovec and Prodan (2009) have pointed out that the training expenses are closely linked to the specific needs that have been identified by companies. Technology absorption could be one of those needs, and the same is characteristic of the 'learning through training' indicator. The capacity for technology absorption could be enhanced by 'learning by doing'. Arrow (1962) was one of the researchers who discussed the ability to generate new knowledge from the learning which is acquired in production routines. Thus, the author stressed on the repetitive activities which lead to the development of productive skills that could further increase productivity with the help of improved manufacturing techniques. Also, in this, he included the ability to generate new technology that is directly applicable in the new production processes. This sort of learning could extend the capacity for understanding techniques which are generated and could be used outside the firm.

Also, Cohen and Levinthal (1990) have found out that the technology absorption capacity could be developed as the by-product of a firm's manufacturing operations. Another study by Abernathy (1978) and Rosenberg (1982) have also concluded that with direct involvement in manufacturing, the firm can be able to recognize the new information which is relevant to a particular product market. Production experience gives a company the necessary background which is needed to recognize the value of methods for the reorganization and automation of the particular manufacturing processes as per Cohen and Levinthal, 1990, p. 2.

Pisano (1996) extended this concept by making a note of the 'practical' aspect which has been observed in computer solutions, prototype testing, laboratory analysis, and other experiments which have not directly related to manufacturing. Studies by Zahra and George (2002) also suggest the interpretation of the complementarity which is present among the three forms of internal learning. This is but a complex process of technology absorption. The same can be understood through learning and through R&D and would be related to phases like (i) acquisition and (ii) assimilation of the technology. This is crucial for the innovations which have a major impact on the domestic market. This could include the full-time work which is done by individuals who are devoted to the understanding and analysis of the major types of information and external knowledge. Also the new information and technology can be understood and used in the R& D laboratories. This needs the mobilizing of technology which is generated in the production plant along with the knowledge that one could attain by training practices. This is possible for transforming the new project or prototype, maintaining the specifics

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of the company's production processes and also for enhancing the ability to explore the new technology absorbed.

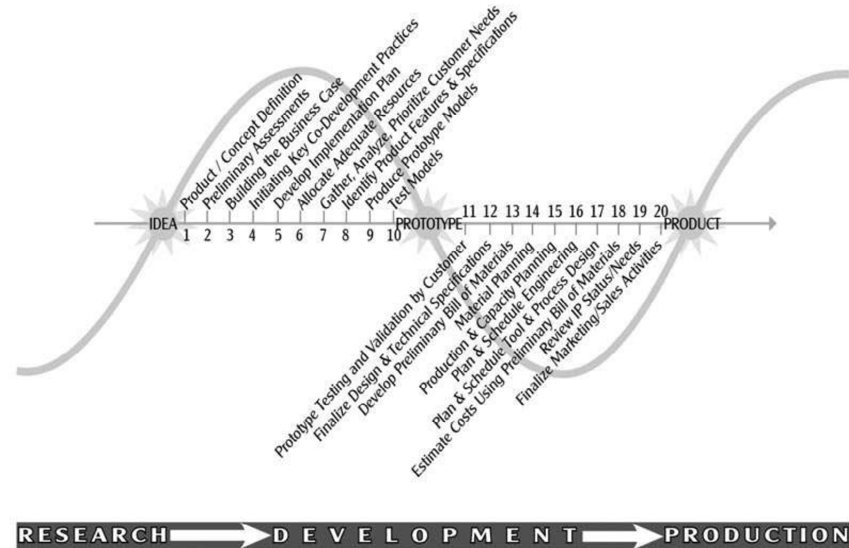


Fig 4.4: *Research to Production Process in a Company*

Greater intensity is also seen among various forms of learning in each phase of the absorption process. Also there is a conceptual similarity among the technology absorption capacity and technological capacity which is very crucial. Research has very often used terms like 'absorption capacity' and 'technological capacity' in similar ways. One should also make mention of the observed conceptual similarities, albeit the same should be referred to neither definitively nor exhaustively. The objective would be to encourage new academic ventures which are capable of increasing analytical rigour when it comes to the use of the same.

It has to be noted that the similarity in the internal aspects that pertain to the firm will make it possible to incorporate external technology. When we look at it from the viewpoint of the 'absorption capacity', it can be concluded that the internal aspects can be revealed in the (i) organizational and management routines and in the (ii) expansion of the tacit skills of individuals along with the (iii) new the products, services and processes which are being generated.

Moreover, it can be said that the 'technological capabilities' can be seen in the total organizational systems; the knowledge and technical skills which the firm's employees showcase and the technical-physical systems like the machinery, manufacturing software, equipment, and products and services as per Figueiredo, 2004. There are similarities between the features which have been listed above. These are then complemented by the fact that, in the application of both the capacities, these aspects could be configured as cumulative training, which is dependent on the past decisions. Thus, there is a specific learning path that could give a firm some specific capabilities needed to absorb knowledge. Moreover, there is similarity in the acceptance of the variety of internal sources of technology knowledge. This could also expand the technology absorption capacity. Here, the idea of 'learning by doing' given by Arrow, 1962 has been found to be insufficient in explaining the technology absorption of external knowledge.

There are other features like labour force skills and the importance of the in-house R&D when it comes to the novel elements of technology being incorporated into the investment projects with the established technology. Here the necessary capabilities could be needed for a more sophisticated engineering and R& D as per Bell and Pavitt, 1995, p. 85. There is a similarity between the two concepts. Here one can see that the internal and external knowledge (training) can be combined with the help of a complex process that involves efforts at many stages.

The same may be needed even if there is no similarity between the factors. Here the concept of absorption capacity shows that the initial stage would involve the acquiring and assimilating of the external knowledge as per Zahra and George, 2002. The concept of technological of feedback can be crucial in relation to the initial phases of the process which includes new considerations on the object which needs technological absorption. It also includes the exchange of information among the 'phases'. The initial phase relates to the need for efforts (which means investment) and the stage of adapting and implementing the new technology can be crucial to specific situations in which the same will operate.

The phase of absorption capacity includes the firm's capacity for transforming the given routines. Thus, the new knowledge (which is embedded in the technology) can be effectively combined with the existing knowledge and technology. The knowledge combination stage occurs when the new prospects and new opportunities are recognized by the company through the advent of the new technology as per Zahra and George, 2002. The changes and improvements which have been done in technology are crucial when it comes to finally absorbing the technology. The technological capacity of the company is the phase which involves the generation of the series of incremental innovations which start stemming from the acquisition of the new productive process.

The innovations can be implemented when maintaining and expanding the company's capacity with time, and this could come from and depend on the technological capacity differentials which have been accumulated in every firm.

The technology transfer includes the process of transmission along with the absorption of knowledge as per Davenport and Prusak, 2000. Here the recipient's firm has the ability to absorb the knowledge which has been transferred on the basis of the degree of the absorptive capacity. It has been seen in the past studies that a low degree of technology recipient's absorptive capacity could affect the intra and inter-firm technology transfer as per Cohen and Levinthal, 1990 and Lane et al., 2001.

Technology absorption can be a costly learning activity where the firm can employ to integrate and commercialize the technology, which is new to the firm as per Goldberg et al., 2008. The examples of absorption include the adoptions of new products and manufacturing processes which are developed elsewhere. It also includes the upgradation of the old products and processes, which help in improving the organizational efficiency, and which could help achieving the quality certification of the product. It has been seen in a study by Kneller (2002) that the technology absorptive capacity will contribute to company's ability of adoption of a particular development for absorption capability attributes which relate to the technology transfer performance.

Also, there was a pilot study done in National Automotive Industry Technology in which Madanmohan et al. (2004) described the extent of company's technological

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absorptive capacity which will determine the level of participation for the technology transfer process. This also lists the type of technology which can operate efficiently. Here, the absorptive capacity concept actually originates in relation to the field of macroeconomic, which represents the ability of an economy to absorb external information and technology as per Adler, 1965.

Some researchers like Cohen and Levinthal (1990) have changed this macroeconomic concept and shown the absorptive capacity as a company-level construct. Cohen and Levinthal (1989) have spoken about the concept of absorptive capacity construct which is the company's ability to assimilate and exploit technological knowledge from the environment. It has been found out that the absorptive capacity will depend on the prior related knowledge and diversity of background. A firm's absorptive capacity is not just the sum of the absorptive capacities which relate to the employees, but also of the firm's organization's ability to be able to exploit information with the help of transfers of knowledge which is done across and within subunits as explained by Cohen and Levinthal, 1990.

They also focus on internal mechanisms in which the structure of communication in transferring knowledge subunits could be able to influence the company's absorptive capacity. One could say that there are many absorption capability factors that determine the performance of technology transfer activity. In research undertaken by United Nations (2005), it has been found that the dearth of sufficiently skilled labour force help assimilate and adapt to the new knowledge of the local conditions. This has been found to be an impediment to foster technology transfer.

A study by Mohamed et al. (2009) shows that technological knowledge base factor, and the level of the employee's readiness can also be included in the experience, technical skills, and communication along with the willingness to learn which could affect the technology transfer performance. There are many factors which inhibit the adoption of new technologies that have been evident in small and medium industries in Malaysia. This was listed by Burhanuddin et al. (2009) like the lack of managerial skills, talented workers, and a limited capacity technology absorption. Moreover, limited staff which conducts research for the new technology and innovation could also be one of the reasons hindering the effective technology absorption.

As per Cohen and Levinthal (1990), the company's ability to absorb new information would be dependent on their employees. There are two elements that are related to knowledge and intensity of effort which could increase the technology absorption capacity. Thus, the employees' ability, which is based on their educational background, and the needed job-related skills could also show the prior knowledge that the firm and organization needs to assimilate.

There is a study by Ashekele and Matengu (2008) on the SME manufacturing enterprise in Rundu, Namibia which showed that a relatively high level of skill in employees gives impetus for a desire to be more competent. It was also found that the willingness of employees to be able to learn and adopt to new technologies could be a vital asset to firm's success. There are studies on technology transfer in defence industry by Haris and Ahmad that have concluded that the retention of employees who have the experience and skills in the firm could make the transfer of knowledge easy and increases the creation of a learning organization. One of the basic concepts in the resource-based view of firm would be that the knowledge can be shared as per Nonaka

& Takeuchi, 1995. Not many companies have included the company knowledge sharing as a crucial part of the absorption process. This is because technological knowledge sharing is seen to be difficult to measure.

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Also, it has been seen that Van den Hooff and Van Weenen (2004) have stated that knowledge-sharing is a process in which individuals exchange their intellectual capital, thus creating new knowledge. Kim and Lee (2006) have also spoken about the technological knowledge- sharing capability, which is the ability of employees to be able to share their work-related expertise, experience, know-how and contextual information with the other employees in a team or work unit.

As per Sung and Gibson (2000), technology transfer can be successful when technology is shared and transferred among various personal, department or organizational level and the same is accepted and understood by the users. As per Li-Hua (2004), without knowledge-sharing and transferring, technology absorption cannot take place. This is because knowledge is the key in controlling the technology. Also, it has been concluded by Lall (2000) that developing countries can obtain industrial technologies through the industrialized world, and the main technology problem for these countries would be to adapt and improve the imported knowledge and equipment.

When one sells a good, the transaction gets complete as this is a physical delivery. At the same time, the process of technology absorption could be a prolonged process that involves local learning which is needed to complete the transaction. Another crucial factor is the working culture which plays a significant roles in affecting the members of an organization when it comes to commitment and satisfaction. This also gives significant contributions which could be influencing the thoughts and feeling which could affect the development of absorption capability. It has also been seen in research that the field of culture and performance studies do have an effect on the technology absorption. In a study by Raduan et al. (2008) on the high technology industry of the European, American, Japanese and Malaysian MNCs, it was seen that there was a possible relationship between the culture of all MNCs and the technological performance. Research and development also affect the level of technology absorption. The Organization for Economic Co-operation and Development (OECD), discusses that the creative work is undertaken on a systematic basis to enhance the stock of knowledge and the utilization of the stock of knowledge which could devise new applications as per OECD, 2008.

R&D capability can be defined as the company's ability to reframe the present knowledge and produce new technology and knowledge as per Fleming, 2001. In their study of innovation effectiveness by Chinho et al. (2011), it was concluded that the different levels of the company's R&D capability can lead decision makers to choose an appropriate commercialization strategy. Also it has been shown in the past studies that the importance of R&D capability is crucial for technology transfer. As per Zhouying (2005), R&D helps a company create new technologies and also enhance existing technologies that are obtained with the help of technology transfer. Cohen and Levinthal (1990) have also discussed the R&D that involves the innovation and learning the same which is the by-product of R&D and thus crucial to enhance a firm's absorption capability. This boosts the efficiency of technology transfer. Another factor found to be crucial for technology absorption is communication capability, which is the foundation for successful human interaction irrespective of the setting in which it occurs as per Marques, 2010.

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An important aspect when it comes to the workplace is communication capability. Managers can take several initiatives that can be crucial in increasing the communication capability present among their employees like encouraging their employees to participate in courses which would enhance the interaction capability. Communication is defined by Narimah and Saodah (2002) as the sharing of information among the two or more individuals for achieving the mutual understanding. There is also a clear definition of communication which is the transfer of messages by speech, writings, images, etc. from the sender to the receiver. When it comes to the technology absorption, there has to be an effective communication capability of the firm.

4.5 SUMMARY

Some of the important concepts discussed in this unit are:

- Technology absorption is a process in which the various features of the technology that are the subject of transfer could be reasonably modified or altered with the needs of the buyer in mind.
- There are many factors which include external and internal factors of a company which affect the technology absorption capabilities. The internal capabilities of the company get affected by the external factors. Thus, the external factors will be studied in relation to their effects on the internal capabilities pertaining to the technology absorption.
- The characteristics of the external knowledge which is to be absorbed could be the basic external parameters that affect the companies in absorbing the technology. Some similarities do exist between the internal knowledge-base of the company along with the external knowledge playing a vital key role.
- Companies can make use of the applied research by themselves or with the collaboration of the universities. Applied knowledge can become an output of applied research and can be used to absorb technology related to the designing new products and modify existing technologies.
- It can be said that the research findings in a new area can be said to be tacit and not codified as there is lack of familiarity to formalize that technology-based knowledge.
- It has also been seen that social proximity can help overcome conflicts that are caused by geographical proximity with the help of social networks. Organizational proximity will depend on the structural relationships which exists among the organizations. Organizations could be communicating among each other and could be the units of the same company.
- In technology absorption, the needs of the buyer of technology gets crystallized and the supplier makes suitable modifications to the technology. The technology is being supplied to the buyer so that it conforms to the requirements of the buyer as much as possible.
- The technology adoption absorption lifecycle is a sociological model which describes the adoption of a new technology or innovation, as per the demographic and psychological characteristics of a given groups of adopters.

Check Your Progress

8. How can absorption capacity be enhanced?
9. What does absorption capacity refer to?

- Sometimes, the technology adoption process might not need technical requirements but could be related to the cultural preferences in the process of technology adoption.
- There are empirical studies that have been undertaken that have stressed the expansion of the absorption capacity; and many researchers have published notes that emphasize the diversity of ways that can be used to absorb knowledge and technology, which is generated from the outside the firm's perimeter.

4.6 ANSWERS TO 'CHECK YOUR PROGRESS'

1. The term 'technology absorption' is defined as a process in which series of technologies are modified or altered to be absorbed while keeping the needs of the buyers in mind.
2. The two important factors that impact technology absorption capability are external and internal factors of a company which could affect the technology absorption capabilities.
3. Knowledge could be of two forms, one being fundamental and the other applied.
4. Codified knowledge can be obtained for technology absorption by transforming knowledge into formal structure so that the same could be better circulated.
5. The major stages in the technology absorption are:
    i. Project Formulation
    ii. Project Execution
    iii. Technology Adaptation
    iv. Technology Absorption
    v. Technology Improvement and Upgradation
6. The technology adoption absorption lifecycle could be said to be a sociological model which describes the adoption of a new technology or innovation as per the demographic and psychological characteristics of a given groups of adopters.
7. The first step in the process of technology absorption is the acquisition that relates to the ability to acquire external knowledge crucial to the company's operations.
8. Absorption capacity can be enhanced by training and education. Training is recognized as a crucial element when it comes to the innovation capacity pertaining to the region or country.
9. The concept of absorption capacity refers to the complementarity of internal and external knowledge that are involved in the innovation process. It is expressed in the firm's ability to learn from the external environment.

4.7 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short-note on the scope of technology absorption.
2. List the factors affecting technology absorption.

3. What are the various types of knowledge required in technology absorption?
4. What are the various processes associated with technological absorption?
5. Write a short note on benefits of adaptation and assimilation.
6. Discuss the significance of codified form of knowledge in technology absorption.
7. Discuss the role played by R&D in transferring technology in the process of technology absorption.

Long-Answer Questions

1. Enumerate the significance of technology absorption in improving productivity and quality of products.
2. Discuss the external and internal factors of companies and their roles in technology absorption.
3. Describe in detail about the various stages of technology absorption.
4. Examine the lifecycle of technology absorption.
5. Analyze the pivotal role played by technology absorption in Indian industry.

UNIT 5 TECHNOLOGY DIFFUSION AND ABSORPTION

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Structure

5.0 INTRODUCTION

Technology diffusion is a process by which innovations are adopted by a population. Whether diffusion occurs and the rate at which it occurs depends on several factors including the nature and quality of the innovation, how information about the innovation is communicated, and the characteristics of the population into which it is introduced. It is the process by which innovations (whether they are new products, new processes or new management methods) spread within and across economies. Thus, diffusion refers to the stage in which the technology spreads to general use and application. Also, diffusion can happen for all kinds of newly emerged technologies that are gradually adopted by societies. The same is strictly associated with communication channels, time and learning abilities of people who have an access to new technology. Several studies have eventually confirmed that in the analysis of innovation, the word diffusion is commonly used to describe the process by which individuals and firms in a society/ economy adopt a new technology, or replace an older technology with a newer. But diffusion is not only the means by which innovations become useful by being spread throughout a population, it is also an intrinsic part of the innovation process, as learning, imitation, and feedback effects which arise from its unfolding, enhance the original innovation. This unit aims at providing a comparative perspective on diffusion that looks at the broad determinants, economic, social, institutional, etc.

5.1 UNIT OBJECTIVES

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After going through this unit, you will be able to:

- Define technology diffusion
- Describe the key diffusion routes
- Discuss the role of innovation and proxies for absorption
- Explain multinational sponsorship of local invention
- Examine diffusion to innovation and the rate of diffusion
- Learn about time, speed and cost of innovation through diffusion

5.2 MEANING AND OVERVIEW OF TECHNOLOGY DIFFUSION



Technology diffusion: It is the process through which innovations are adopted by a population.

Technology diffusion is the process through which the innovations are adopted by a population. The rate at which diffusion occurs is dependent on various factors. This encompasses the nature and quality of the innovation, the information pertaining to the innovation which is communicated, and finally, the characteristics of the population for which it is introduced.

Technology diffusion is thus the process which describes the takeover of a certain technology by other actors or organizations other than the organization that originally started using the technology or service. These actors or organizations could usually be related to the original actor. This is also known as the stage in which the technology spreads to the general use and application. Diffusion could happen for all kinds of newly emerged technologies that are gradually adopted by societies. The same is strictly associated with communication channels, time, learning abilities of people who have an access to new technology. Thus, it is the process by which an innovation is selected, communicated, and adopted via various means over time by a group or organization.

5.2.1 Innovation: Concept, Types and Role in a Company

The term 'innovation' has been defined in various ways. The Merriam-Webster dictionary defines it as an introduction to something new, whether a new idea, or a new type of method or device. The author John Emmerling stated that 'innovation is creativity with a job to do'. On the other hand, the authors George Land and Beth Jarman in Breakpoint and Beyond: Mastering the Future Today, state that 'Innovators can hold a situation in chaos for long periods of time without having to reach a resolution…won't give up … have a long term commitment to their dream … innovators introduce a maximum of tension into the thinking process, unifying concepts that often appear to be opposed, solving problems which appear impossible'.

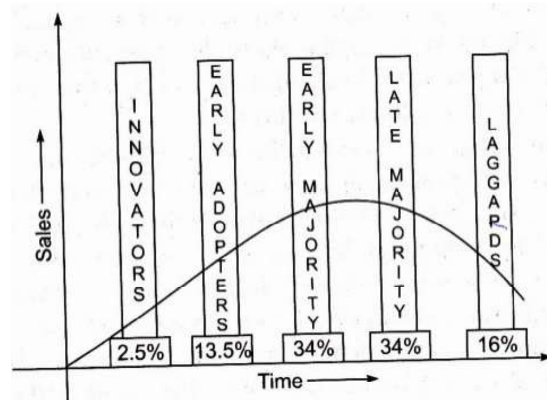


Fig 5.1: *Product Innovation*

Innovation could be said to be the act of introducing a new thing or doing something in a varied way. Innovation in business is different from creativity. The latter could be associated with the formulation of new ideas. In comparison, innovation refers to picking up these new ideas and having them implemented in the marketplace. At the same time, creativity could be said to be a simple element of the innovation process. This is a process by which new ideas will brings in new products, services and procedures. Business scholars are also crucial in the success of the company innovation, which is due to growing international competition. Thus, innovation has become more important for the companies since the 20th century.

Many organizations see innovation as a crucial growth and success parameter. Innovation being a growth factor, it is important to understand as to what does the term 'innovation' means in the business world. Incremental innovation could aim at making better a settled system which is present in the firm but needs a better, faster and cheaper approach to them. It could thus be called 'Market Pull' Innovation. At the same time, radical innovation looks at new technologies along with new business models which exit in breakthrough businesses. Thus, a term used for this type of innovation could be 'Technology Push' Innovation.

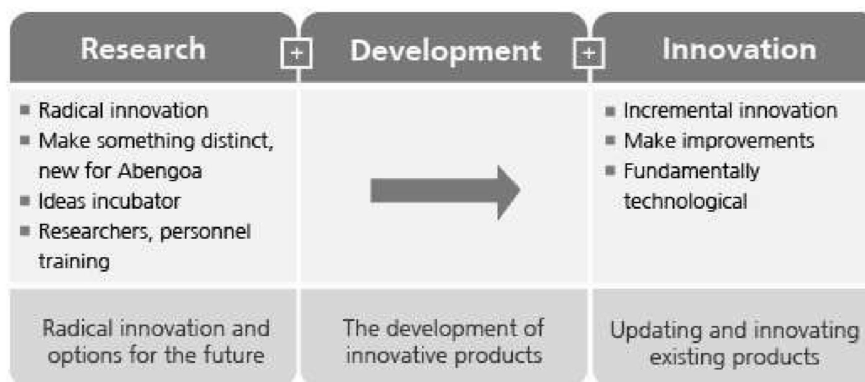


Fig 5.2: *Research, Development and Innovation*

Innovation has to have the following parameters to be effective. These are:

1. Innovation has to create value for people through implementing new ideas.
2. The initial point in innovation will be the generation of creative ideas. Thus, innovation is a process of taking these ideas to market for their benefit or use.

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Innovation: It is the act of introducing a new thing or doing something in a varied way.

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3. Innovation would be anything which brings in a new perceived benefit and this is meant to be for the customer or employee.
4. Innovation is a constant search for a new discovery, or an experimentation, or a development with an imitation and adoption of an absolutely new product, or a new processes or a new organizational set up.
5. Innovation is the conversion of knowledge along with the ideas to a said benefit, which can be used for commercial use and also for the cause of the public good. The benefit from the innovation could be a new or improved product or a new process or service.
6. Thus one can say that innovation can be defined as a process which changes the ideas to a special commercial value.

Here the differentiation between 'invention' and 'innovation' would have to be made clear as invention could be the creation of a new idea or concept, whereas in comparison, innovation would be a new concept getting converted to a commercial success for the widespread use.

Essentials of Innovation

All innovations come with expenditure. When we talk of the commercial usage of a new product then innovation can consist of product extension which means that the same base product has been taken in by a slight modifications or an identical product is launched in a new segment. It could also be a new platform product which would include the net product which can bring in the product extensions. The new-to-the-company products along with the set of new-to-the-world products, which have never been seen before or no market exists for such new product also come under innovations.

It is true that innovation is crucial in any business strategy. It could be said that many companies are spending their cash and revenue on the innovation for new product and service. It is also true that the company which succeeds in innovation of a particular product generally become successful, as it gets the pioneer advantage. For example, when we speak of a product like Tata Nano, it was a new innovation in the 'one lakh' car category. No other car was priced as low as Tata Nano in the market. For a company to be able to innovate, the company has to have sufficient infrastructure. It can also be said that any innovation has to be practical. Taking the same example of innovation of the car Tata Nano, the same seemed to be impractical till the time the car was actually ready for manufacturing.

Innovating is not easy. The company has a risk attached to the company's capital when the company is trying to innovate. A company could initiate new project but might not have the sufficient supporting infrastructure to support the product. Also it is not known as to how long will it take to complete the forecasted product. Another very important factor is the estimated costing of the product. The cost and budget of the new product will always be subject to change as the prices of commodities and raw material keep on rising with passing time.

One more parameter which could be dicey, is the market demand. It is very important to judge the market demand of the new product. The cost of innovation will not be justified in case the demand of the market does not suffice as compared to the cost of the primary innovation. Also a good innovation could pave way for new

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innovations in the company. At the same time, one has to know how well the innovation will work in the market. With a dynamic market like the one operating in today's world and highly competitive business arena, it becomes very difficult to analyze the actual estimated demand of the market for the new product. It also so happens that sometimes what the company finds out in its research before the innovation might not actually work when the product enters the market.

One good example of the same is the case of the product named: "Pepsi Blue". The company had launched this innovative product named Pepsi Blue at a time when the "Cricket World Cup' fever was high among the youngsters. It was primarily targeted at the fans of the Indian cricket team whose jersey colour for the world cup match series was blue. The product was launched with a proper market research where the company found out that the product was liked among the consumers. After the launch of the product, however, things were different. It was seen that the product was not accepted among the youngster for many reasons. One of the reasons given for the rejection of the product was that the colour blue of the drink and the fizz related to the same reminded them of Surf which was a detergent. Some of the consumers said that the product had a very slimy taste which stuck to the tongue. These features were not present with the primary beverage colour of Pepsi which was black. This type of failure is crucial for a company. It can give a company loss, both in terms of revenue and the image of the company. One should thus plan the expected new innovations for the company only when the company could pay for the said project. Also the company should calculate the payback model for all such innovations.

Innovation usually results from trial-and-error experimentation and sometimes occurs incidentally where researchers produce something other than what they intended. It is due to the growth of knowledge and the access to the information with the help of technology revolutions that many researchers in the late 20th century have been making the ideas to innovations more rapidly in comparison to their predecessors. Also there are some confluence of factors which also lead to the innovation of the business setting, which includes the research environment, company strategy, market need and company resources.

Innovation as a Priority

It is true that all businesses look to bring in more innovative products. In one of the known innovation surveys it was seen that about 90 per cent of businesses took the process of innovation as a top priority for them. The importance of innovation is on a rise. Here, when one has a look at the current day economic scenario, one could say that the innovativeness is by far a major factor for influencing strategic planning. One could also conclude that innovation brings in wealth creation. The efficiency in implementing innovation is crucial in case of business success, when seen in the long run, and thus this could sustain business growth.

Innovation is a set of combination of ideas, along with some of the key objects like employees or inventors. These inventors bring in a new business idea and also bring in technological revolutions. Valuable innovations, and the new products or the services have to get a strong enough position to bring in progress by dynamic commercialization processes. Also, this innovation, if commercialized, has to be set in the right marketplace. One could also list the explanation of management expert Peter

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Drucker who feels that an established organization has to necessitate innovation, and if it will not innovate, it could come across decline which may lead to its death. Some firms take up measures so as to strengthen their innovative ability. These companies become dependable in an operating a new system of innovation, which is an important indicator in case of the corporate sustainability.

It can be said that tough competition could become a major driver of innovation. The intensity of competition becomes a vital factor of innovation along with the productivity expected from the innovation. Here innovation is not only limited to products or services, but also entails new processes in new business systems along with the new methods of management that have a dynamic impact on productivity along with the growth. If a company develops innovations then it has to have sufficient infrastructure for the innovations and also has to make them practical. Innovating is not easy as it also entails into it the risking of the company's capital. In case one undertakes the project and does not have sufficient supporting infrastructure, then one cannot commit as to how long it would take to be completed; what will the cost estimate be and how the market demand will be estimated. It can be possible that the project has a primary infrastructure, as it could be a base for other innovations. The company has to know as to how long the primary project would take to complete before the other expected new innovations pay for the said project, in case there is a payback model at all.

Technology could be said to be a success factor as is understood by it definition, but the same could increase the benefits-to-costs ratio along with this success. Thus, it becomes crucial for the innovator to be very careful so as to make a profit. Technologies could just have a moderate change in technology, and also do have a dramatic competitive consequences. When we look at the relevance of technology, this could be looked at as big or small. Here the value of the new innovated product or service is of importance. Also, when we look at the relevance of technology it could be said to be complex or a simple one. The value of technologies can be thought of in the firm as their technical achievement, or a new design technology. The business industry and the style of technology are not important, but what is crucial is the technology's impact on the competitors. The innovator who brings in the idea or implements technology and who maintains the speed of the technology till the end result is also crucial. The company thus needs a person who can foresee the future and work to implement it.

The future of a lot of businesses rely on the ability to innovate. Here, also important is competition in the market, which today is truly fierce. The knowledge of technology also spreads quickly. Thus, a company has to keep up in terms with the current business practices, along with the competition's expectations for the market for survival. From an organizational perspective, it can be said about managers who could encourage technology. The same is due to the value which the product can capture. It is true that innovative employees will enhance productivity with the help of creating and executing new processes, which could then further enhance the competitive advantage. Also, the same could lead to a meaningful differentiation. It has been seen that innovative organizations could get to be more adaptable in the external environment. The same could help the companies to react faster.

When we look at technology from the managerial perspective, it can be seen that innovative employees will get more motivated in an organization. At the same time, empowering employees to innovate could also enhance the work processes

which will bring in a sense of autonomy which could also enhance job satisfaction. Also, it can be said that empowering employees to get into a broader organization-wide technology will bring in a sense of teamwork that could make sure that the employees are actively aware and are working towards the organizational objectives and strategy. Managers who promote an innovative environment can also see the value of increased employee motivation, autonomy creativity and stronger teams along with strategic recommendations. Managers can also have the same with the help of the top-down support given to employees, which gives clear roles and responsibilities when they are allowing individuals' freedom in their work.

Here the individual could be supporting the HR and IT departments which are crucial in providing training and tools that are crucial for internal innovation. The same will need open-minded leaders in managerial positions. These leaders could also help in guiding the employee efforts and at the same time, take care of the diminishing employee creativity.

Innovation is also estimated to increase the benefits-to-costs ratio. What is crucial here is that the innovation should be able to produce profits for the company. It can be said that innovations can be classified on the basis of different dimensions. There are also numerous studies that differentiate between incremental and radical innovation. Gatignon et al. (2002), describes incremental innovations 'those innovations which can increase the price/performance to a given rate and the same being consistent to the present technological trajectory'. On the other hand, radical innovations can be said to be a set of innovation which can bring in an 'advance in the price/performance in comparison to the existing rate of progress.' When one talks of the technological changes, then one might not take into account the given innovation. It can be said that an innovation could be systemic in case it is incremental or radical.

Many organisations can and do survive even with lesser level of innovation. Their stress in this case is to provide the quality products and also update the level that maintains the competitiveness in the market. This is also done for products which have a long lifecycles and innovation.

In recent times, certain trends have emerged that could drive the innovation process. This is because of factors like globalisation and outsourcing. One can see an increased push to enhance efficiency and effectiveness in the organisations. Organisations have to have the good products to survive and for the same they need the innovative processes which could lower their down costs and enhance the productivity.

Another parameter which is crucial for the level of innovation which a company should list is the consumer expectations which are related to the market. Customers demand products that can improve and make their lives easier. It is true that modern consumers are better informed and have better options when it comes to what they buy. Thus, it can be said that the customers will not accept any amount of mediocrity as they now have alternative option.

New technology could be said to be one of the primary ways which could differentiate the product from the competition. In case one cannot compete on price, then one will have to innovative products so that one could make the business stand out from the crowd. For example, when a company comes up with a new technology,

it will become the first to market a new product. This could bring in a significant advantage in terms of building the customer base. It will be crucial when it comes to competing with the company's products when they are considered as obsolete and out of date.

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When one is investing in new technology one has to see that many businesses will just try to survive with copying the new technologies of other companies. Thus, they will not benefit from their own hard work. For example, when mobile companies brings a new technology in three mobiles sets, the same is copied by others. For examples, when a mobile company brought out a cell phone with a camera, it was immediately copied by the rest.

It has also been seen that new technology is very crucial in the advancement of society. It can also be said that the new and innovative products can enhance the standard of living and will give people the opportunities to enhance the lives of the products. Breakthroughs which are seen in medicine and technology have been crucial in enhancing the living standards in today's world. New technology has brought in many significant improvements in the operations of businesses. It has also helped closing the gaps between different markets.

One could list many a reasons which are crucial in the generation of new ideas that are critical in the success of a business. It has been seen in organizations that priorities along with the sector-specific issues have to strike a balance. At the same time, businesses which fail to innovate will have a risk of losing ground as that to the competitors. They could also be losing the key staff and might just be operating inefficiently. New technology becomes a USP or a differentiator among the market leaders and the competitors.

Innovation can help the company to discover what opportunities are present now and also talk of the opportunities which are likely to emerge in the near future. Successful businesses will be the ones which will respond to the current customer and their organizational needs, but will also anticipate future trends. Innovation thus helps the company in generating an idea, product or service which would allow them to meet this future demand more effectively. Innovation could make the company ahead of the competition and bring in a shift in the markets, technologies and their trends.

One should include the act of innovation as a crucial part of the overall plan. Thus, through innovation, the company should try and make the most of what one already has. It is also true that innovation is not only about the designing of the new product or service but also stresses the existing business processes and how one could improve efficiency of the same. Innovation also brings in new consumers and helps in cutting down waste and enhances profitability of the firm.

The company has to remember that it should keep on innovating and hence enhance their business practices. This could attract better staff members and also help in retaining the staff. The will be crucial when it comes to the long-term health along with the performance of the business.

Innovation helps in forming a unique selling point

It is true that in today's world, it is very important to be different from the competitors. The consumers will look at innovation as an added value to a company. In case innovation

is used properly, then innovation could also be a very valid commercial advantage. The same is the case in saturated or shifting markets. The customers could very well pay more when the product is well-designed and the innovative product or service, than choosing a cheaper, but less exciting rival.

It is true that consumers today are looking for quality of the product. It is also true that Indian consumers today can pay more for a branded product of good quality. The same is provided by all the brands in India. Here is where the term innovation becomes crucial. When all mobile companies give a similar feature and the consumers cannot decide which one to choose, then innovation becomes important. In case a company comes with an innovation of dual sim, then this company gets a competitive advantage over the others. It would not take consumers time to switch to this new company for the innovation it has provided to the consumers.

Another factor crucial here would be the price of the product. In case, an incremental innovation has been made by a company at the same cost at which the company was selling a product, then this become an added advantage for the consumer. Also, the new innovation will make the company a pioneer in this field of product. It is very crucial for a company to be a pioneer in its field. For example, whenever one will talk of glucose biscuits, one will recall the brand Parle, whenever one will recall a brand of antiseptic, the consumer will remember Dettol and whenever a consumers will recall a brand of detergents, the first brand name which could come in the mind would be Surf.

This brand recall is because in all of the fields listed above companies have been pioneers of these given product. It would thus be a very strong mental connect between the product, brand and the consumers mind. It will be very difficult for any other company to delete this recall present in the mind of the consumers. For example, Savlon was a brand which did want to compete with the pioneer of antiseptic product which was the brand Dettol. It also brought in a USP which was the antiseptic will not leave a burning feeling when applied. Despite the fact that Savlon did come with an innovative idea, the same could not be successful in competition to Dettol.

5.2.2 Technology Adoption/ Diffusion

In modern times, technological change and innovation can be thought to have begun in the fifteenth century in Europe. This was when printing technology was introduced. It had huge economic and political effects on society when the technology was adopted and diffused in society. Internet technology is the 'printing' technology of today and has the potential to cause similar changes on modern society.

The term 'adoption' refers to the stage in which a technology gets selected for use by the individual or the organization. Innovation can also be used with the nuance of a new or 'innovative' technology being adopted. Diffusion is the stage in which the technology spreads to general use and application. 'Integration' shows a sense of acceptance, which is related to transparency, in the user environment.

According to author Everett Rogers (1986), who is considered the 'guru' of adoption/diffusion research, the diffusion of innovations talks of three important ways in which the adoption of a technology is different from previous innovations. These are:

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1. The first difference is that the critical mass of adopters is required to convince the 'mainstream' of the technology's efficacy.
2. The second is that the regular and frequent use of the technology is needed to ensure success in the diffusion process.
3. The third is that the technology can be said to be a tool which can be applied in many ways and the same can be done for different purposes. The same is a part of the dynamic process that can change or modify individual adopters.

Technology generally embodies many technologies which include e-mail, chat rooms, databases, information and education resources, etc. Technology might have in it many elements which constitute the community, its language, rituals, symbols interaction, and communication methods. Thus, it is crucial to judge the environment into which the users are using the technology. 'Visionary' innovation along with the 'pragmatic' application could start with grass-roots enthusiasts who could try and enter this environment. The culture or community could see a new technology as a threatening competitor when it comes to establishing norms in the existing culture or community.

5.2.3 Adoption/Diffusion Theories

The 'top-down' and 'bottom-up' models of diffusion show a directional perspective to the process. Also, there is the theory of dichotomy which talks of the scale of innovation efforts and differentiates the macro-level theories and micro-level theories.

1. Macro-level theories stress on institution and systemic change initiatives. At the same time, innovation takes into consideration the broad aspects of instruction and thus includes the wider range of technologies.
2. When one studies micro-level theories, the focus is on the individual adopters along with the specific innovation or product instead of the large-scale change.

Rogers (1995) has presented four diffusion theories which have been explained below:

1. **Innovation Decision Process Theory:** Here, the potential adopters of a technology could progress over a period of time with the help of the five stages in the diffusion process. The first stage is innovation or knowledge. The second stage is that the employees be persuaded about the value of innovation which is also known as the stage of persuasion. The next stage is that they have to decide to adopt the technology, which the stage of decision. The next stage is that the innovation has to be implemented, which is the stage of implementation. The last stage is that of the decision which has to be reaffirmed or rejected. This is called the stage of confirmation. The stress is on the user or adopter.
2. **Individual Innovativeness Theory:** Here the individuals who are the actual risk takers and innovative, will try and adopt an innovation earlier in the continuum of diffusion.

3 **Rate of Adoption Theory:** The diffusion can take place in a period of time as the innovations through which the diffusion is going through can be slow. The same can have a gradual growth period, which could be followed by a dramatic and rapid growth, and then on, a gradual stabilization could be reached finally before decline.

4. **Perceived Attributes Theory:** There could be five attributes on which the innovation is judged. These could be tried out which is known as the triability and the results can be observed for the same which is known as the observability. In addition, there is an advantage of innovations and the present circumstance. This is termed as the relative advantage. Technology diffusion could be complex to learn or use. This is termed as the level of complexity of the technology. The technology could fit in and could be compatible with the circumstances in which it is being adopted. This could be termed as the compatibility of the technology

These factors can be considered in the context of a top-down or a bottom-up diffusion process. They can be viewed at a macro-level or micro-level reforms. There is but a diffusion theory dichotomy which is crucial for the discussion of innovation. This differentiation is between a determinist which is a developer-based focus and instrumentalist which is an adopter-based focus. Determinists feel that the technology is a primary cause of social change. This process is thus taken as a series of revolutionary advances which could be seen as a factor which is out of direct human control. The focus here would be on the innovation's technical characteristics. The successful diffusion could be assumed to be the result of the innovation's technological superiority. Here the innovation's developer could be seen as the primary change agent.

When it comes to the instrumentalists, this process is evolutionary, and the main causes of change could be seen to be the social conditions along with the human aspirations which are crucial for the change and improvement.

The focus would be on the user or the adopter of the technology. The same will be viewed as value of the tool which is bringing about the desired change. Here, human control on the innovation could also be taken as a crucial issue. The same is seen to be essential for understanding the social context for which it is being used and the function that it intends to serve.

Comparative Approaches to Technology Diffusion

Technology offers opportunities for the creation of new and significantly usable applications. But technological functionality cannot be seen as the sole force which is driving its rapid adoption. It is the hope which is held by many in the community that new ways of learning a technology could lead to a higher or increasing rate of its adoption. Also, many instructional technologists and educators do not advocate technical superiority as the same alone will not be sufficient for the success of the technology diffusion for an innovation.

The author David Jaffee has voiced in his analysis of resistance to asynchronous learning networks (ALN) that technologies like Internet/Web-based learning applications are similar to the classroom teaching which could only be established in practice and will depend on the cultural tradition of the adopters of technology. This also centralizes power and influence for the trainer and serves as a focal point for professional identity. Jaffee also suggests that the institutionalization of the classroom teaching model could be a major factor in the hindrance to adopt ALN technology.

It has been found that the employees exhibit less opposition to the use of a new technology in a company when they have a reliance on training for the same. There is also study which proves that techniques like the virtual classrooms through ALNs and

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Web-based learning modes could be crucial in the imparting of technology knowledge to the employees. It has also been seen that the professional identity of an expert in the technology knowledge presentation and the adopter reaction to it, that is, a disinterested and disengaged audience, could also affect the effort of the diffusion process.

In this process, the focus has shifted to the potential adopter along with the organization into which the technology has to be integrated. It can thus be said that the adopter-based, instrumentalist approach which incorporates the macro-and micro-level perspectives can be seen and judged as the most widely used for the promotion of the adoption and diffusion of Internet technology.

There are some studies like the one done by Ernest Burkman's (1987) which stress on the user-oriented development approach. This exemplifies the currently favoured approaches for the adoption and diffusion of the instructional technology along with the Internet technology in the process of diffusion of technology. The technology could be adopted in the following five adopter-focused steps:

1. The first step is identification of the potential adopter
2. The second factor would be the measurement of their relevant perceptions
3. The next step would be to build an adopter-friendly product design and development
4. The next step would be to inform the potential user or the adopter about the product
5. The last step would be support after adoption.

There is an alternative model which is developed at the University of Minnesota's Telecommunication Center which does a complete analysis of adopters' need and user characteristics with the identification of the relevance of the new educational technology. It also studies the relevant and appropriate features and factors which effect technology diffusion.

Tessmer (1991) focuses on the need to judge the environment in which the potential adopter will be using the technology. This would include identifying the needed physical and use characteristics which could pertain to the instructional situation along with the support system. This approach could be intended to ensure the correct, actual, and continual product use.

In the adoption analysis approach as given by Farquhar and Surry, 1994, it has been considered that the process of diffusion could be seen from the broader perspective of the user-perception along with the organization attributes. This could result in a plan for the adoption of technology which could be rooted with respect to the organizational context. The same could address the issues of concern to the intended user. Also, it has been seen that the product and application design and development could be significantly influenced by this approach.

It is known that no single approach or process can be said to be sufficient for ensuring successful innovation adoption. Also, it is clear that the Internet and Web-based technology can be said to be the individual-user based when it comes to the application. In addition, the diffusion process has to start at that level. There should be a focus on the potential adopters along with their characteristics in the context of the environment in which the technology is about to be used.

Differentiation of Technology Adopters

It has been seen in the traditional diffusion continuum that there are five categories of participants. The innovators are the experimentalists and 'techies' who are interested in the technology itself. The early adopters of the technology could be technically sophisticated and interested in technology that pertains to solving professional and academic problems. Also, it can be seen that the early majority, namely the pragmatists can constitute the first part of the mainstream. Moreover, the late majority could be less comfortable with technology and the same could be sceptical when it comes to the mainstream. One has to mention the laggards who might never adopt the technology and could be antagonistic and critical in the use of the same by others. As discussed, the distribution of the said groups in the adopter population is seen in a familiar bell-shaped curve.

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Need-based Diffusion Strategies

It is true that the needs of the early adopter-early majority differs and the same has to be considered when one is designing diffusion strategies. This could enhance the likelihood that a technology could be successful in integrating the systems by groups which lie beyond the innovators and early adopters as per Geoghegan, 1994.

1. **Need for Recognition**

   It is true that there are chances of successfully 'selling' the innovation to the pragmatic early majority. This could increase in case the differences could be addressed in terms of their perceptions and needs. The same could also be recognized as this is a distinct group in a community and could be made a part of the planning and policy making process. There are attempts being made to 'convert' these groups from the point of view of the innovators and early adopters that are likely to be futile. It can be disastrous to impose the technology on this groups.

   The diffusion of innovation in relation to the late majority and laggards groups can be more likely to occur through this early majority involvement as the vertical lines of communication between the three groups can become direct as compared to the innovators and early adopters.

2. **Need for Vertical Support Structure**

   There is a strong need of technology adoption that starts from the grassroots. This pertains to innovators and early adopters, who have a strong technology orientation. They could thus get the support with their own initiative. The narrowly focused technical support staff can become more of a threat and can discourage the early adopters. These people thus have a need for initial training and support which could be relatively easy to accommodate.

   In addition, the members of the early majority may have no interest in the technology and may also exhibit some sort of technophobia. The introduction to the technology for this category of people should be related to the perceived program and process needs of these people.

   As these people tend to focus vertically in a discipline, the training and support should be provided by the staff who enjoy discipline credibility which will be

best received. Also, such training and support could be more transferable when it comes to the late majority and laggard groups.

3. **Well-Defined Purpose**

   The existence of a technology can be a reason for the innovators and early adopters to pursue it further. There is also an inclination towards experimentation and the innate interest in technology which could dispose them to adopt it. This could give them a satisfaction of 'finding a problem to fit the solution'. It is true that the early majority will try and derive their purposes from the problems which are related to their disciplines.

4. **Ease of Use and Risk of Failure**

   The early majority has a tendency of aversion to risk which could become a need for ease of use. Also, there could be an early success in case one has to adopt and diffuse the technology. There could be an overlap with the support and training requirements which is also very obvious.

5. **Institutional Administrative Advocacy**

   In the top-down adoption effort institutional sponsorship and support can be given for a new technology. The innovation could be mandated and grant money or other funds committed. It is true that without the advocacy and resource commitment for the technology, it would be difficult for the institution's 'policy makers' to explain the relevance of the diffusion process to the employees. On the other hand, the innovation that occurs from the bottom-up would also need institutional attention, and the administration as an entity could also emulate the early majority in comparison to the innovators and early adopters. When the institution initiates the innovation from the top, the perspective becomes pragmatic and is based on the problem or need for the given technology. The same could also relate to the financing, scheduling, staffing, teaching, and communication.

The mind-set could be similar to the early majority and thus there is a need for advocacy to occur in case of the activities that could promote adoption by the early, late majorities and laggards. Any successful diffusion strategy has to meet these needs. One of the research undertaken by the University of Colorado, by Wilson, Ryder, McCahan and Sherry (1996) shows some crucial principles that pertain to some crucial situations for the effective networked learning environments.

An innovation could be accepted and integrated to the early and late majorities. This could be seen as the initial success and subsequently the same could be built upon. E-mails are crucial in the introductory phase as they can be easy to use and help in successful communication with the employees and involve them in the technology diffusion process. There is a need of 'hand-holding' in the process of integration when the technology applications are introduced. Live peer support can help in assistance and encouragement; along with the person-to-person communication which could promote the diffusion throughout the company. Also, when one comes to the recognition of the peers, one could line up a network of online mentors who could expand the potential of the support structure and thus promote the exchange of these innovative techniques.

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Check Your Progress

1. What do you mean by technology diffusion?
2. What do you understand by the term 'innovation'?
3. How is innovation different from creativity?
4. What are the types of innovation?
5. List the three important ways in which the adoption of interactive communications is different from previous innovations.
6. List some the adoption/ diffusion theories.

The early and late majorities could be said to be the pragmatists who will judge the technology in terms of real problem. They thus look at task solutions. Activities designed to introduce and teach the technology have to address these needs. It can be seen that the institutional administrations need to emulate this pragmatic perspective. The access to information and resources could be useful in the intra and inter-institutional communication and the same could also help in the administrative needs. This could thus establish a well-defined and recognizable process of technology diffusion.

One should not impose a technology to the employees on the basis of explicit mandates and requirement. This top-down scenario will not be very effective. This is because the technology is available to anyone who has the mind to adopt it. Policies and procedures that are promoting the technology have to grow naturally from the given application, and the incentives for using the same have to be tied to its practical use. The adoption and diffusion is likely to occur when the incentives and policies encourage a natural acceptance and the use of the new technology.

The integration of a technology like the Internet and making it 'effort intensive,' would be better in the process of technology diffusion than the traditional and more rewarded--endeavours. In case, the innovative behaviour has to be sustained, there would be a need of a recognized and acknowledged system which pertains to rewards. The same should run parallel to the one associated with 'traditional' technological pursuits.

5.3 KEY DIFFUSION ROUTES: TRADE, FDI, R&D, LABOUR MOBILITY AND TRAINING

Let us not study some of the key routes of diffusion. These are as follows:

1. **Trade:** Trade is a good route of technology diffusion. Technology diffusion in trade would depend on the location of trade, culture of the population, technological upgradation of the region and their attitude towards the new technology.
2. **FDI:** Foreign Direct Investment or FDI could be crucial for the act of technology diffusion. It is when MNCs from a developed nation enter through FDI to a developing nation that the technology diffusion takes place. This will have to be supported by proper training to the companies of the developing nations.
3. **R&D:** Innovation and research effect the level of diffusion. A company which has a well-established R&D department and resources are more likely to undergo technology diffusion easily. Such a company would have a set of experts who could make the process of technology diffusion easier.
4. **Labour Mobility:** It is true that developing countries provide cheap labour to developed countries. Thus, this moment of labour could lead to technology diffusion among the developing countries. For the same, the support of the technology provider is crucial.
5. **Training:** Training is a crucial and an integral part in the abortion and diffusion of technology. Training should be a bridge between the traditional modes of technology and the newly adapted technology.

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FDI: It is an investment made by a company or individual in one country in business interests in another country, in the form of either establishing business operations or acquiring business assets in the other country, such as ownership or controlling interest in a foreign company.

Check Your Progress

7. List some of the diffusion routes.
8. What is the role of R&D in making the process of technology diffusion easier?

5.4 PROXIES FOR ABSORPTION

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Innovation has been present since time immemorial. The early innovations in society took time to be established. For example, printing technology, transportation innovations, gunpowder, took a very long time to reach mainstream levels of society. It took them time to become a part of everyday life. As per Basil Blackwell and Samuel Eilon, who are the authors of The Global Challenge of Innovation, innovation came in very slowly in some products.

The coming of an innovation and its acceptance started enhancing rapidly with the collaboration and cooperation of science with related crafts and industries in the late 18th and early 19th. It was this partnership among science and industry that helped scientists to give practical, reproducible technologies that were cheap to make. It is due to this new collaboration that innovation grew quickly. Moreover, due to this collaboration, researchers have been working independently and also as members of companies who specialize in developing, manufacturing and marketing innovations in this period. Also, many innovations have not made it to the market.

Due to collaborations between science and industry, numerous companies, especially those specializing in chemical, power, and communications, started making and maintaining their in-house research and development divisions. This trend started in the 20th century. This also helped in getting rid of the barrier among the innovator and company and resulted in companies controlling the patents for the new inventions.

5.4.1 Patent Citations

Patents are viewed as intellectual property rights in some of the crucial economic innovative outputs. These patent citations provide a convenient metric of how existing pieces of patented knowledge could help in the creation and appropriation of new patented knowledge. The data on patent citations from the European Patent Office (EPO) and the U.S. Patent and Trademark Office (USPTO) is a part of the knowledge absorption process to study flows of knowledge in the ECA and the rest of the world.

5.4.2 International Co-invention

It is the openness to trade and foreign investment which helps the company to tap into the benefit from the global pool of knowledge. Patent co-inventions could also help build these global linkages. This could also create knowledge spillovers. For example, there is a large fraction of European and Central Asian (ECA) patents which are obtained in the European Patent Organization. These are co-invented with inventors of the western economies and Germany which have a crucial role. A co-invented patent could be said to be one in which at least one named inventor is located in the ECA region, and at least, one inventor is located outside the region.

5.4.3 Multinational Sponsorship of Local Invention

Foreign firms can make crucial contributions to the ECA-regions inventive activity. The local R&D operations of the companies and their sponsorship of local inventors could bring in a large fraction of the total patents which could come from ECA countries. In case, the indigenous ECA patents lag behind other regions in terms of the degree to

which they build on prior inventions and extend it, the ECA patents created through multinational sponsorship are better connected to global R&D trends and generally represent inventions of higher quality.

5.5 DIFFUSION TO INNOVATION, RATE OF DIFFUSION AND TIME, SPEED AND COST OF INNOVATION THROUGH DIFFUSION

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According to management guru Peter Drucker, 'Innovation is the specific instrument of entrepreneurship... the act that endows resources with a new capacity to create wealth.' Many and varied theories talk about the process of innovation. Let us discuss some of them

5.5.1 Diffusion of Innovations (DoI) Theory

One of the major theories of innovation is the Diffusion of Innovation or DoI theory by the scholar Roger Clarke. The theory describes the patterns of adoption, explains the mechanism, and assists in predicting whether and how a new invention will be successful. The DoI Theory talks of the technological innovations which could get communicated by some channels and some of the social system members. The theory lists the major stages of technological innovation which can be listed as follows:



DOI Theory: It is a theory that seeks to explain how, why, and at what rate new ideas and technology spread.

- Knowledge
- Persuasion
- Decision
- Implementation
- Confirmation

The theory also talks of the important characteristics which are crucial for innovation. These are as follows:

- Relative Advantage
- Compatibility
- Complexity
- Trialability
- Observability

The theory also explains the adopter categories. These are:

a) Innovators (the venturesome)
b) Early Adopters (the respectable)
c) Early Majority (the deliberate);
d) Late Majority (the sceptical)
e) Laggards (the traditional)

It is crucial to explain the various adopter categories listed above. The innovator is the niche segment of consumer who would be the first one to use the innovated product. These people are generally the leader of fashion and will be the first ones to dare to won a differentiated or innovative product. They are a set of consumers who

Check Your Progress

9. What do you mean by patents?
10. What role does multinational sponsorship play in local invention?

are the risk takers and they will take the risk to try a new product like that which is it eh market. These consumers primarily consist of a set of younger and teenagers.

The earlier adopting individuals will not just be the youngster or teenagers but will be among the age group which have little more years of education. These set of consumers also have a higher social status and are also seen to have upward social mobility. These individuals are seen in larger organizations and have greater empathy. They are also recognised with a lesser level of less dogmatism and have a greater ability to handle abstractions. They have a higher level of rationality, show a higher level of intelligence, and can deal well with uncertainty and risk. Also, these sets of consumers have higher aspirations, and will have a high level of contact with people, and will show a greater exposure to mass media. They will also be more exposed to interpersonal communications channels and will also have active information search.

The early majority is a set of consumers who actually start the mass marketing of the innovated product. This is when the product is more seen around and the product starts moving around in the market. These early majority are a group of individual who would not have brought a product as an initiator but have been waiting for others experience to see and use the innovated product.

Coming to the category of the late majority, these will be the set of consumers who will start buying the product only when the same has reached the maturity stage of marketing. At this time of the product cycle, the product will have made a place in the market, will be readily available and would be very often seen among the prospective consumers groups. This is when the late majority feels like buying the product or trying to use it based on the majority using it.

Laggards are a set of people who buy the product when the product has already started its decline phase. At this point of time, another new product will already have started the initiation stage with some other prospective consumers. For example, take the example of LED. The LED market now is saturated and LED TVs are very common among prospective consumers. Although a new technology which is 3D TVs is already entering the market, some laggard consumers will try and buy LED TVs. This is because they know that the product has done well with time. Also, this type of consumer could take advantage of the price lowering which is done for the outdated product like LED TVs. In case they want to buy 3D TVs, the same will be very expensive. Thus, these laggard set of consumers will try and use the outdated technology TVs which is the LED model of TVs.

Rate of Diffusion

The rate of adoption or diffusion is defined as the relative speed at which participants adopt an innovation. It is usually measured by the length of time required for a certain percentage of the members of a social system to adopt an innovation. It is determined by an individual's adopter category. In general, individuals who first adopt an innovation require a shorter adoption period (adoption process) when compared to late adopters. Within the adoption curve (Fig 5.4) at some point the innovation reaches critical mass. This is when the number of individual adopters ensures that the innovation is self-sustaining.

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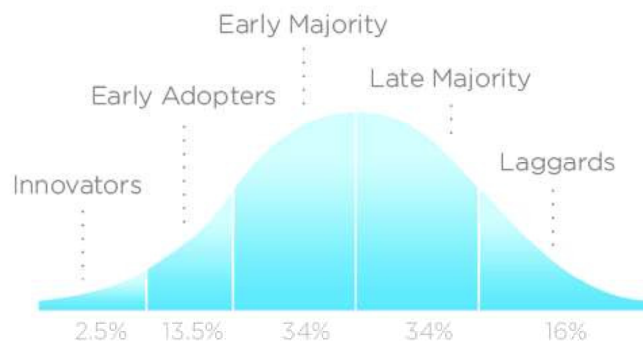


Fig 5.3: *Innovation Adoption Lifecycle*

Some of the major roles which are crucial in the innovation process are listed as follows:

1. **Opinion Leaders:** They are those who have a more informal influence as related to the behaviour of others.
2. **Change Agents:** They are the ones who can be positively influenced by the innovation decisions. These people are mediators who are present between the change agency and the social system.
3. **Change Aides:** These are said to be complementary to change agent and have intensive contacts with the clients.

The DoI Theory could be said to be one of the best theories when it comes to the analysis of descriptive tool but it is also questionable when one is predicting outcomes. It can be said that providing a guidance to increase the rate of adoption is crucial here.

Stage-Gate Model for Innovation

Another important model here could be said to be the Stage-Gate model. This describes the process of a firm in the task of structuring the product development process with the use of sophisticated systems which can be taken in the project phase along with their milestones. The model was a result of 60 case studies on the efficient product innovation processes that were studied. In the studies, the analysis showed that the product development process could be said to be the key factor that is critical in the determination success of the new products. These case studies were live practical cases in the North-American industry in the 1980s. The study analysed the basic parameters of the competitive challenge in the growth of Japanese competitors as studied in their home market. It has been seen that when the Western world saw stagflation, then the effective use of corporate resources became crucial.

The model was devised by a Canadian academic, Dr. Robert G. Cooper, who was a professor of Industrial Marketing at McMaster University's Business School, Hamilton, Ontario, Canada. This model was formulated by him in the year 1986. This model is similar to and relates to the New Product Portfolio Management which is also a topic described in the 100 articles and ten books published by the author.

In the Stage-Gate model the most crucial aspect is the product innovation which is a clearly defined process. The main objective of the model would be to enhance the quality in the process of product innovation. The same is done by enhancing the process

of the manufacturing of the product. The Stage-Gate has been formulated in many stages. The stages have been described for the process of innovation. The stages are also listed period-wise in which the work is performed. The same has been formulated with the multidisciplinary product development teams.

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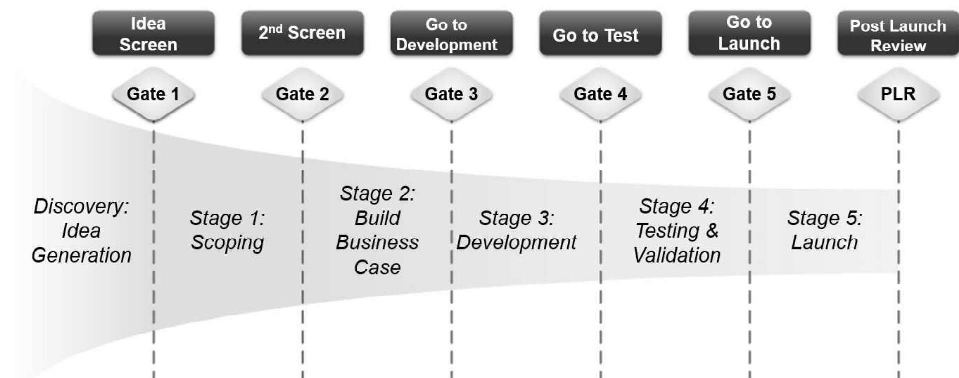


Fig 5.4: *Stage-Gate Process*

The Stage-Gate model has four to seven stages which include their gates based on the organization's particularities. When we explain the model, the five stages could be listed as follows:

1. **Scoping:** It could be said to be the quick-scan in the project's technical merits related to the market prospects.
2. **Build Business Case:** It can be thought of as a critical paper which connects to the stage of make or break of the project.
3. **Development:** It is that stage of the business case plans that could get transformed to concrete deliverables.
4. **Testing & Validation:** This is the stage of the model that provides a validation to the whole project including the product itself that could get evaluated in the production process. The same could also entail customer acceptance or the financial merit of the given project.
5. **Launch:** It will be the last stage in the innovation process as per this model. Here the full commercialization of the product happens. This is just the beginning of production stage and could be named as the actual stage of commercial market introduction of the product.

It can be concluded that Cooper's Stage-Gate model can be seen as a broader model for product based organizations. The firms which emphasize products like mobiles and laptop can use these tools for their product development operations. The basic assumption here would be that the firm should not lack new ideas and should be able to fulfil all the major objectives.

5.5.2 Theories of Innovation

Some of the other theories which can explain the process of innovation are as follows:

1. **Transformational Theory of Innovation:** This is by far one of the most difficult changes which could lead to innovation. These types of innovations are done by big companies. These are crucial innovation which could help in developing the

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whole industry. For example, Tata Nano is one such transformational innovation. The Rs. 1 lakh car actually revamped the way business was being conducted in the automobile small car segment. It is, however, true that these so- called transformation innovation could also get obsolete very soon. It can be said that it would be crucial for the organizations to pursue the innovative ideas which could get obsolete in a short period of time. Some of the companies do go for a transformational change voluntarily as they want to become pioneers in the market for their own new product. This holds true for the mobile manufacturing industry for example. In the industry, most of the companies like Apple and Samsung have been changing their models of mobile handsets rapidly. When one of their new product reaches the market and is about to reach saturation, the company itself kills the product and launches a new series. This is done to beat competition. In case Apple Company does not demolish its own products, the same could be done by Samsung which is a major competitor. Thus, the market share will get shifted to the competitor. Before this happens, Apple Company demolishes its currently successful product to launch a new model of mobiles.

2. **Incremental Theory of Innovation:** In case the transformational innovation is present at one end of the innovation spectrum, then one could find incremental innovation on the other end. The Incremental Theory of Innovation is what we see in most of products. For example, an airbag facility in a small-sized car is an incremental innovation. A glass holder in the car is also an incremental innovation. Thus, incremental innovation is the improvement which is done in an existing product or a brand so that the firm can stand out among competition. There are many pre-requisites which are crucial for the incremental innovation processes. One such factor is the multi-disciplined, or the cross-functional collaboration. Here the company will have to be strong in implementation the necessary change in the product. The same will have to be done with definable metrics that are crucial in decision-making point which includes the processes like Stage-Gate. For an effective innovation, the decision makers have to have consensus-based decision making. This consensus has to be maintained among the multiple stakeholder functions. It is true that factors like the internal competition are very crucial when it comes to innovation. What matters most is the people, operational resources, distribution channel, competition, etc., which are crucial in planning to design an innovation.

   It is true that in any of the innovation mentioned above, a lot of resources are needed to implement the innovation. This will then enhance the business performance. This innovation which is done in the good times could be vital of a company in the bad financial times.

3. **Breakthrough Theory of Innovation:** This could be explained as the third type of innovation. This is middle way between the incremental and transformational innovation spectrum. In a breakthrough innovation, there would be a significant change for the innovating organization. This innovation could be done in terms of cultural and systems support. This type of innovation will help the company to bring in a very strong competitive advantage. The same would become sustainable after a shorter period of time. This type of an innovation is

more risk-taking. This is why in such an innovation what is crucial is the decision-making. The breakthrough ideas could help the company find new markets and also venture into a new business opportunity. The same may have not been existent for the company before.

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For this type of an innovation, the company has to have a 'frame of reference' in relation to which one will be able to deliver the metrics. The same was also seen in the Stage-Gate process. The customers will not have a set frame of reference when they are judging an idea. Moreover, in this sort of innovations, the business analysts will have no track record of the past performance of this type of product. This could mean that there are no sales numbers, or trial data by which the company could build volumetric. Thus, it can be said that the breakthrough will need a higher level of consideration. The level of uncertainty attached to this type of innovation is very high.

5.5.3 The Linear Model of Innovation

The Linear Model of Innovation can be said to be one of the early models of innovation which suggests that the technical change can only happen in a linear fashion starting from invention to innovation to diffusion.



Fig 5.5: *The Linear Model of Innovation*

Thus, this model could be described as a three stage process. Here, the priority is scientific research which is the basis of innovation. This will thus play the role of the later players in the innovation process. There are many current models of innovation which describe the various traditional approaches to innovation like the Actor-Network Theory or the social shaping of technology. These models describe how innovation works. Some of the current ideas of open innovation and user innovation could be taken from these models. There are two versions of the Linear Model of Innovation. They are as follows:

- Technology Push model
- Market Pull Model

It has been seen that in the 1950s to the mid-1960s, the industrial innovation process was seen as the linear progression from scientific discovery. The same was seen to be done with the technological development in the companies in the marketplace. As per Roth well (1994), the stages of the 'Technology Push' model could be shown as are given in the chain below:

Basic Science → Design and Engineering → Manufacturing → Marketing → Sales

It has been seen that from the mid-1960s to the early 1970s, there has been an emergence of a second-generation innovation model which is termed as the 'market pull' model of innovation. This is a simple sequential model in which the market is the main source of new ideas when it comes to the directing of R&D. This would have a reactive role in the process. When one lists the major steps of the stages of the 'market pull' model, the same could be listed as follows:

Market Need—Development—Manufacturing—Sales

The linear models of innovation have had many criticisms which relate to the linearity of the models. The given models also do not take into consideration some of the feedbacks and loops which are present among the various stages of the process. There are also many shortcomings and failures which could happen at some of the stages. This leads to a re-evaluation of the earlier steps of innovation.

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5.6 SUMMARY

Some of the important concepts discussed in this unit are:

- Technology diffusion is a process by which innovations are adopted by a population. Whether diffusion occurs and the rate at which it occurs is dependent on several factors including the nature and quality of the innovation, how information about the innovation is communicated, and the characteristics of the population into which it is introduced.
- Several studies have confirmed that in the analysis of innovation, the word diffusion is commonly used to describe the process by which individuals and firms in a society/economy adopt a new technology, or replace an older technology with a newer.
- Diffusion could happen for all kinds of newly emerged technologies that are gradually adopted by societies. The same is strictly associated with communication channels, time, and learning abilities of people who have an access to new technology.
- Innovation could be said to be the act of introducing a new thing or doing something in a varied way.
- Innovation in business is different from creativity. The latter could be associated with the formulation of new ideas. In comparison, innovation refers to picking up these new ideas and having them implemented in the marketplace.
- Innovation usually results from trial-and-error experimentation and sometimes occurs incidentally where researchers produce something other than what they intended. It is due to the growth of knowledge and the access to the information with the help of technology revolutions, that many researchers in the late 20th century have been making the ideas to innovations more rapidly in comparison to their predecessors.
- Innovation helps the company to discover what opportunities are present now and also talk of the opportunities that are likely to emerge in the near future. Successful businesses will be the ones that respond to the current customer and their organizational needs, but will also anticipate future trends.
- Adoption refers to the stage in which a technology gets selected for use by the individual or the organization. 'Innovation' is used with the nuance of a new or 'innovative' technology being adopted. 'Diffusion' is the stage in which technology spreads to general use and application. Integration shows a sense of acceptance, which is related to transparency, in the user environment.

Check Your Progress

11. What is the Diffusion of Innovations Theory by Roger Clarke?
12. List the important characteristics of the DOI theory which are crucial for innovation.
13. Who was the academic who devised and formulated the Stage-Gate model for innovation?
14. What is the transformational theory of innovation?

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- The 'top-down' and 'bottom-up' models of diffusion show a directional perspective to the process. The Theory of Dichotomy which talks of the scale of innovation efforts and differentiates the macro-level theories and micro-level theories.
- Innovation that occurs from the bottom-up would also need institutional attention, and the administration as an entity could also emulate the early majority in comparison to the innovators and early adopters.
- The coming of an innovation and the acceptance of most of the innovations started rapidly enhancing with the collaboration and cooperation of science with the related crafts and industries.
- The Stage-Gates model was devised by a Canadian academic, Dr. Robert G. Cooper, in the year 1986. This model is similar to and relates to the New Product Portfolio Management which is also a topic described in the 100 articles and 10 books published by this author.

5.7 ANSWERS TO 'CHECK YOUR PROGRESS'

1. In the analysis of innovation, the word diffusion is commonly used to describe the process by which individuals and firms in a society/economy adopt a new technology, or replace an older technology with a newer.
2. Innovation can be said to be the act of introducing a new thing or doing something in a varied way.
3. Innovation in business is different from creativity. The latter could be associated with the formulation of new ideas. In comparison, innovation refers to picking up these new ideas and having them implemented in the marketplace.
4. Two important types of innovation are: Market-pull innovation and Technology-push innovation.
5. There are three important ways in which the adoption of interactive communications is different from the previous innovations. These are:
    i. The first difference is that the critical mass of adopters is required to convince the "mainstream" teachers for the technology's efficacy.
    ii. The second is that the regular and frequent use of the technology is needed to ensure success in the diffusion process.
    iii. The third is that the technology can be said to be a tool which can be applied in many ways and the same can be done for different purposes. The same is a part of the dynamic process that could change, or modify the individual adopters.
6. Some of the diffusion theories are as follows:
    i. Innovation Decision Process Theory
    ii. Individual Innovativeness Theory
    iii. Rate of Adoption Theory
    iv. Perceived Attributes Theory

7. Some of the key diffusion routes are:
   i. Trade
   ii. FDI
   iii. R&D
   iv. Labour Mobility
   v. Training
8. Innovation and research affect the level of diffusion. A company that has a well-established R&D department and resources are more likely to undergo the technology diffusion easily. Such a company would also have a set of experts who could make the process of technology diffusion easier.
9. Patents are viewed as intellectual property rights in some of the crucial economic innovative outputs.
10. Foreign firms can make crucial contributions to the ECA-regions inventive activity. The local R&D operations of the companies and their sponsorship of local inventors could bring in a large fraction of the total patents which could come from ECA countries.
11. The DOI theory describes the patterns of adoption, explains the mechanism, and assists in predicting whether and how a new invention will be successful.
12. The important characteristics DOI theory are as follows:
    1. Relative Advantage
    2. Compatibility
    3. Complexity
    4. Trialability
    5. Observability
13. The Stage-Gate model was devised by the Canadian academic Dr. Robert G. Cooper, who was a professor of Industrial Marketing at McMaster University's Business School, Hamilton, Ontario, Canada.
14. The Transformational Theory of Innovation is by far one of the most difficult changes which could lead to an innovation. These types of innovations are done by big companies. These are crucial innovation which could help in developing the whole industry.

5.8 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short-note on the process of technology diffusion.
2. What are the reasons why innovation has become more important for the companies today?
3. List the main parameters for being termed as an effective innovation.
4. What are the essentials of innovation?
5. What do you understand by the rate of diffusion?

Long-Answer Questions

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1. Enumerate the significance of technology diffusion in improving productivity and quality of products.
2. Companies are taking innovation as a priority. Explain the various reasons with examples.
3. Describe in detail about the impact of adoption in new educational technology.
4. Analyze some of the major roles which are crucial in the innovation process.
5. Discuss in detail the Incremental Theory of Innovation.
6. Analyze the two types of the Linear Model of Innovation.

UNIT 6 TREND AND HURDLES IN TECHNOLOGY TRANSFER AND ABSORPTION

Structure

6.0 INTRODUCTION

As is now universally acknowledged, technologies have been the drivers of economic development worldwide. The need for enhanced capabilities has made technology absorption and transfer a priority for the company and is high on the international development agenda. There are a number of conceptual models that identify the stages involved in technology development and transfer. Technology absorption and technology transfer relate to existing and emerging technologies and include technology diffusion and technology cooperation with regard to equipment, know-how and software as well as their associated management systems. But, not all companies have had the capacity to absorb and maintain the technologies they require. They could be said to be facing several hurdles, especially those from developing countries like India. However, these transactions may occur through various levels like government-government, public-private sector or private-private sector partnerships. Human resource and institutional developments play key roles, while partnerships and networking along with collaborative R&D may be more crucial for other developing countries. Information development is important for all countries, as it is the cornerstone of technology transfer. Developed countries are expected to facilitate and support human resource capacity building in developing countries.

Despite the renewed efforts of the international community and the growing recognition of the importance of technology, the full potential for the absorption and transfer of these technologies remains unfulfilled. In particular, these have fallen short of the expectations of developing countries. In addition, international technology cooperation and partnerships have yet to be fully utilized to accelerate wide-ranging

technology transfer for economic growth and poverty reduction. In addition, a company needs to take some measures to enhance the ease of technology transfer and absorption. For countries like India, the capability of the local industry to be able to absorb the technology could be said to be crucial when one is transferring a technology. Here, education and innovative knowledge imparting skills could be crucial for effective technology transfer and absorption.

This unit aims at analyzing various trends and hurdles in technology absorption and transfer and explain comprehensively what countries like India need to undertake to avail and embrace the technologies for enhancing productivity and growth.

6.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Discus the trend and hurdles in technology transfer and absorption
- Explain absorption strategies for acquired technology
- Discuss the role of new and improved technology
- List the attitude of technology transferor and transferee firms
- Explain the role of quality of education and human resources in the transfer of technology
- Understand taxation, fiscal policy and PPP for technology transfer and absorption
- Discuss about the status of technology absorption in India

6.2 TREND AND HURDLES IN TECHNOLOGY TRANSFER AND ABSORPTION: AN OVERVIEW

Businesses and groups of workers sometimes face hurdles in technology transfer and absorption. There is lack of propensity to innovate. For instance, companies in which employees are given a lot of responsibility for initiating new projects tend to be more innovative, as do companies that offer their workers a good degree of job security (which is the freedom to make mistakes and be free from disciplinary action for the same). Also, there is minimal interference from superiors when one has to improve creativity. It can thus be said that the most innovative companies will match the skills and interests of the workers who are assigned the job or tasks.

Some of the issues faced by firms in the transfer of technology are shown in Figure 6.1.



Fig 6.1: *Issues faced by Firms in the Transfer of Technology*

There are companies in the United States which could be said to be innovative as they are placed high in comparison to other firms. The same is the case if the traits of categories are in their order of importance. These companies are considered to be practicing freedom, idea support, risk taking, generating ideas, and so on. This helps them manage the hurdles to the technology transfer and absorption.

Measures

Some of the major measures which a company can take to enhance the ease of technology transfer and absorption are:

1. Freedom and control to undertake tasks when under supervision.
2. Independent project management which includes the ability of the supervisor to match the tasks of the individual. Protection of the group from destructive outside intervention could also be a part of innovation.
3. Resources which are sufficient to realize ideas.
4. Given continuous encouragement, and the upper management support and the ability to take risks.
5. The corporate climate which is compatible to making suggestions and experimenting with new things in business. Some of the organizational attributes that are crucial for innovation could be recognition and feedback, execution of ideas with freedom and appropriate tie and a challenging environment.

Personality Types of the Worker

Along with these attributes of company environments, some of the personality types of the worker will also promote technology transfer and absorption.

One could categorize the personality types into three types which are: risk takers, undertakers and caretakers. These are found in many of the groups that contribute to the organizational creative process. Here, it could be said that the people are generally leaning toward one personality type. It is also true that the same person may also occasionally show all the three traits of categories. One category which is crucial is the risk takers in the organization. They have creative traits which have been described earlier. Caretakers are a group who try to maintain the status quo. These people see the changes as threats, and not opportunities. They also respond to outside influences

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in case they are forced to do so. When one looks at undertakers, they are the people who will be very much resistant to change. They will try to neglect and bury projects and suppress the ideas to maintain the status quo. These people are detrimental for the business innovation process and could also take over some crucial organizational roles which could impose the innovation process.

Technology transfer and absorption gets a lot of advantages from the diversity of personality types which fill up different roles. In case every person of the company turns out to be very innovative, and nonconformist, then the company could lack the balance and grounding of business. What is needed is the multiplicity of personality types along with traits which could be accommodated through the innovation process that would require the given five general personality types.

Role of the Innovation Process

The first role of the innovation process could be the idea generator, who is the person who needs to satisfy market needs. The same could be done by thinking of new ideas, or finding solutions to problems, and judging the ideal opportunities. Idea generators could be said to be experts in a single field and could also recognize niche opportunities. These people could enjoy working alone. These people could think abstractly and conceptually.

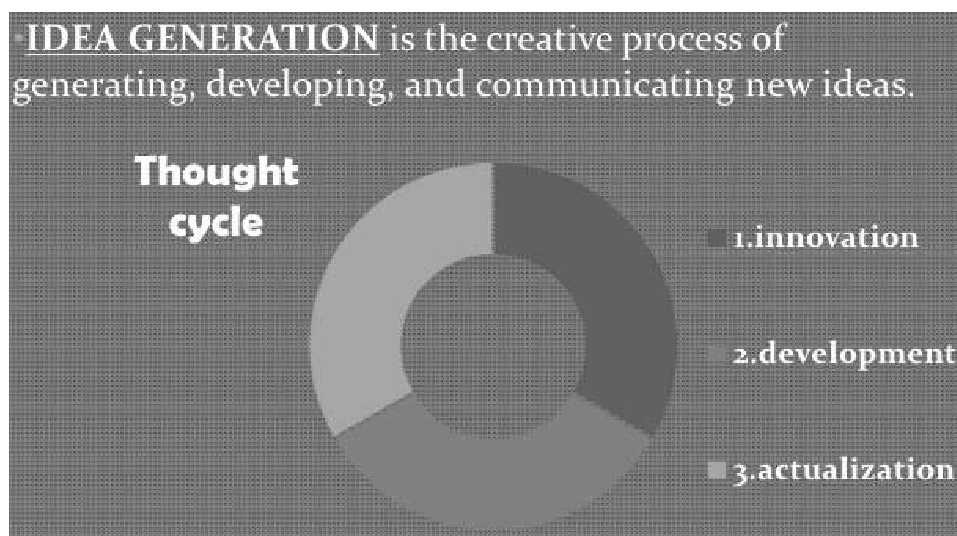


Fig 6.2: *Idea Generation*

Champions, the second role in the technology transfer and absorption process, sells the idea to others in the organization and secure resources to execute ideas. Individuals who will be playing this role could be referred to as entrepreneurs. When one looks at idea generators, then the champions could be more apt to have a broad range of interests, and have a general knowledge of the various arenas of the company or industry. These people are also willing to work with other people. These people will be more energetic and will be willing to take risks.



Entrepreneurs: It refers to a person who sets up a business or businesses, taking on financial risks in the hope of profit.

Project leaders will have the third role in the process. They coordinate activities like leading teams, organizing and planning projects, and are also helpful in balancing project goals. The same could be done by them with by balancing the available resources

and the firm's needs. It has been seen that the effective project leaders will be good at working with people and will increase group cooperation. These people will also be adaptable to the company politics and will have a broad knowledge of company functions. Their function will include the production, finance, and marketing.

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The fourth role needed for the effective technology transfer and absorption is that of the gate- keepers who will take charge of judging the influences which are present outside of the organization. This is done through conferences, and journals of other companies. Gate-keepers will be crucial in passing the information to others and will become an important source of information. They can also be champions or critics, idea generators, and leaders. This helps in enhancing the group communication along with the project coordination. Good gate-keepers like working with other people. They also have a high degree of technical competence. These gate-keepers will have a non-innovative personality but will still be advantageous to the group.

The coaching role in case of the organizational innovation process will entail encouraging the team members, and protecting the team from the unsafe outside forces (like the undertakers of the other related departments), and making a support system of top-level management. Here, the employees, who are into the coaching role in the innovative process, could be said to be good listeners. They will be less opinionated as compared to their co-workers, which is a characteristic not related to the stereotypical creative personality. In a firm, the effective coaches could also be proficient at politicking with the proven experience of formulating new ideas.

Internal Factors of Technology Transfer and Absorption

The internal factors for the transfer of technology and its absorption are:

- **Unexpected Occurrences:** Some of the issues which can come up in technology transfer and absorption will entail mishaps, like failed product introduction. It is from these unexpected failures that the new ideas come from the new information which is invented. For example, one successful brand, NutraSweet's artificial sweetener got created by accident in a project which was done on some unrelated sweeteners productions.
- **Incongruities:** Incongruities in technology transfer and absorption could come from a difference in a company's perception and reality. For example, in case the demand for steel has been growing between 1950 and 1970, but the profits in the steel industry have decreased. This incongruity brings in opportunities for innovators so that they could make for example, a steel mini mill, which was less expensive in the process of making of steel.
- **Process Needs:** Technology transfer and absorption that are inspired by the process needs, will be the ones which are made to support another product or process. For example, in advertising, the introduction of mass-produced newspapers was possible due to innovation. Newspaper publishers also brought up ads so that the expense of printing the newspapers could get covered. Also, they started using the new equipment which made such printing possible.
- **Industry Changes:** Industry changes can be listed as the internal impetus which is crucial for technology transfer and absorption. The same could bring in a rise or fall of successful innovators. Here, we can take the example of International Business Machines Corp. (IBM) which became a leader in the computer industry

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in the year 1970s and early 1980s. But the company failed when it had to respond to a market and had to change in the late 1980s from mainframes to smaller computer systems. The same was done specifically to the workstations and personal computer networks. Thus, IBM's share of the computer market which also brought in innovative newcomers, emerged.

There are external impetuses which could promote technology transfer and absorption. Demographic changes also affect aspects of business. For example, the coming of Asian and Mexican immigrants to the United States brought in a new market niches for many companies. Also, an increase in the education of Americans brought in a dearth of qualified workers which were meant for low-paying jobs. Many companies started developing new innovative automation techniques to meet this challenge. Changes in perception help in technology transfer and absorption as well. Although healthcare in the United States is getting better day by day and also becoming more accessible, people are becoming increasingly concerned for the health and the need of a better and more accessible healthcare. The given change in perception brought in a huge market which is present today for health magazines, exercise equipment, vitamin and protein supplements.

One of the special external impetuses in technology transfer and absorption has been new knowledge, or technology. Whenever a new technology comes up, innovative companies start exploiting the new applications and markets. This continuous effort of innovation is crucial for making a culture of technology transfer and absorption.

6.3 STATUS OF TECHNOLOGY ABSORPTION IN INDIA

The capability of the local industry to be able to absorb the technology is crucial when one is transferring a technology. Therefore, it is important to examine the capabilities of Indian industry when it comes to technology absorption.

Industry in India has a strong R&D base. Research establishments are certainly capable of absorbing and translating critical technology and transforming them into products and systems needed by Indians. Let us look at technology absorption in India by looking at the defence industry. In the defence industry, the public sector company Bharat Electronics Limited (BEL) spends about 5 per cent of its annual sales turnover on R&D, and has about 1200 qualified engineers working on R&D projects. Also, assimilating technology has no such hurdles to BEL. There are other capable Indian industries as well. They take the help of institutes like Ordinance Factory Board and the Defence Research Development Organization (DRDO) labs for enhancing the indigenous capability for technology absorption. However, this aspect of Indian industry faces a technical challenge when it comes to the absorption of imported technology which is carried out in a specified time-frame and applies directly for new products or in related areas for diverse product ranges. The substitution of proprietary components with indigenous ones can only partially takes us forward in areas of improving existing products. As a result, about 70 per cent of defence technology in India is exported from other countries. In the defence industry as well as other industry, the emphasis has to be on internalizing the capabilities in such a way that new and diversified products could be developed in-house by leveraging the transferred foreign technology.

Check Your Progress

1. What is technology transfer and technology absorption?
2. Why do companies face hurdles in technology transfer and absorption?
3. List some measures the company needs to enhance the easy technology transfer and absorption.
4. What do you mean by idea generators?
5. List the internal factors of technology transfer and absorption.
6. How do industry changes affect the innovators?
7. How does a new technology work as a special external impetus in technology transfer and absorption?



Incentive: It is a thing that motivates or encourages someone to do something.

Government Initiatives for Technology Absorption

There are several schemes and incentives undertaken, from time to time, by the Ministry of Science and Technology, the central level authority as well as by the State Governments. These schemes largely aim to build strong science and technology infrastructure in the country, which can further the process of innovation, promote technology commercialization and thus, can help to raise socio-economic conditions of the people.

One of the main initiatives taken in this direction is the launch of Technology Promotion, Development and Utilization (TDPU) Programme which is aimed at promoting technology development and industrial research in the country as well as encouraging its utilization by various section of economy, be it industry, academic, scientific institution and the society at large. The programmes and activities under this scheme are centred around promoting industrial R&D; development and commercialization of technologies; acquisition, management and export of technologies; promotion of consultancy capabilities; etc.

Under TDPU Programme, there is one very important programme component called "Technology Development and Innovation Programme (TDIP)", which aims to develop technologies and promote innovation in the country. TDIP is sub-divided into 2 programmes, namely:-

1. **Technology Development and Demonstration Program (TDDP) :** It was earlier known as 'Programme Aimed at Technological Self-reliance (PATSER)'. It is a plan scheme of Department of Scientific and Industrial Research (DSIR) to promote industry's efforts in development and demonstration of indigenous technologies, development of capital goods and absorption of imported technologies. That is, its broad objectives for achieving self-sufficiency in industrial growth are:-
   - Supporting industry for technology absorption, development and demonstration.
   - Building indigenous capabilities for development and commercialisation of contemporary products and process of high impact.
   - Involvement of national research organisations in joint projects with industry.
   - Technology evaluation in selected sectors.

To achieve such objectives, DSIR provides on a selective basis partial financial support to research, development, design and engineering (RDDE) projects proposed by industry in the following areas:

- Development and Demonstration of new or improved product and process technologies including those for specialized capital goods, for both domestic and export markets.
- Absorption and upgradation of imported technology.

The partial financial support by DSIR is primarily meant for covering expenditure involved in prototype development and pilot plant work, test and evaluation of products flowing from such R&D, user trials, etc. Bulks of costs of the project are from the industry's resources.

In general, following types of proposals for RDDE projects are considered for partial financial support:

- Projects undertaken solely by in-house R&D units of industrial firms.
- Projects undertaken jointly by Industry and National R&D Organisations and Institutions.
- Collaborative projects of common interest to the concerned sector/area, proposed by a group of industries/users, national research organisations, etc.
- Projects may cover products and processes in various important industries such as metallurgy, electrical, electronics, instrumentation, mechanical engineering, earth moving and industrial machinery, chemicals & explosives, etc.

2. **Technopreneur Promotion Programme (TePP) :** It was launched to tap the vast innovative potential of the citizen of India. TePP is a mechanism to promote individual innovators to become technology-based entrepreneurs (Technopreneurs). Thus, its main objectives are to:-
    - Promote and support untapped creativity of individual innovators.
    - Assist the individual innovators to become technology based entrepreneurs.
    - Assist the technopreneur in networking and forge linkages with other constituents of the innovation chain for commercialization of their developments.

The activities under TePP include providing financial support to selected and screened individual innovators having original ideas for converting them into working models , prototypes and so on. TePP assistance is provided to the innovator to meet expenditure on the following:

- R&D/Engineering consultancy
- Procure small equipment, tools etc. required
- Raw Material/ Accessories (for prototype/process trials),
- Fabrication cost (for prototypes)
- Patent guidance and support
- Manpower
- Testing & Trials
- any other relevant costs



Manpower: It refers to the number of people working or available for work or service.

TePP support to the innovators is limited to 90% of the total cost of the project and remaining 10% is to be borne by the innovator/inventor.

Further, 'Innovation of Science Pursuit for Inspire Research (INSPIRE)' is another such innovative programs proposed by the Department of Science and Technology for attraction of talent to science. The basic objective of INSPIRE would be to communicate to the youth population of the country the excitements of creative pursuit of science and attract talent to the study of science at an early stage and build the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base. INSPIRE Scheme has included three components. They are: (i) Scheme for Early Attraction of Talents for Science (SEATS); (ii) Scholarship for Higher Education (SHE); and (iii) Assured Opportunity for Research Careers (AORC).

6.4 NEED FOR NEW OUTLOOK ON ABSORPTION STRATEGIES FOR ACQUIRED TECHNOLOGY

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Organizations that are looking at fostering technology transfer and absorption have to wrestle with two main problems, that is, risk-taking and failure aversion. The technology transfer and absorption includes the risk and the risk brings with it the possibility of failure. Failure can be seen as a black mark but it should be taken optimistically as a learning experience. Leaders, who make way for technology transfer and absorption, should not be scared of failure. If they are scared of failure, then they will never be able to incorporate the innovation which they want to truly meet for satisfying the customers' needs.

Design thinking is one of the path which leads to risk-taking which is manageable, and can be driven for maximizing the effectiveness of technology transfer and absorption.

Technology transfer and absorption talks of something new and different. Even in that case, paying attention to companies which are fully innovative in their industries could always be a good practice.

Some example of companies that are using these principles of design thinking to reach the strategic goals are as follows:

- Proctor & Gamble (P&G) has spoken of technology transfer and absorption which has been practiced under the former CEO A.G. Lafley. It has been seen that under his tenure, P&G's value enhanced by about $100 billion or more. Also, in the year 2000, the company has a 10 billion-dollar consumer brands which today has increased to 22.
- Kaiser Permanente is a large not-for-profit health provider located in the USA. Kaiser's National Facilities Services group has been practicing technology transfer and absorption practices since the past five years. They have been working on Total Health Environment, which is a program which has been applying the design thinking in every sphere of Kaiser's operations. The same comes from medical records to colour palettes. The outcome of the same is that there is an improved patient health, soundness of sleep, satisfaction, speed of healing, along with an appropriate cost control.
- Square is another example of a company which is associated with technology transfer and absorption. The same started with its plugging device which helps millions of mobile vendors. They are not limited to the cash payments and for the expensive credit card machines. Square noticed that the economy was now becoming paperless soon and the company provided customers to keep pace with the same.

Technology transfer and absorption could be said to be important in the business world today. Organizations have to start fostering technology transfer and absorption. Driving business results through these innovative ideas with the help of technology transfer and absorption process will put the ideas to work which will be done for the companies and the customers.

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6.5 CREATING NEW/IMPROVED TECHNOLOGIES: HURDLES AND ATTITUDE OF TECHNOLOGY TRANSFEROR AND TRANSFEREE FIRMS

The attitude of the technology transferee is crucial in the effective technology transfer and absorption. In a project, after the objectives and goals of the project are established, then ideas can be generated from brainstorming sessions. This can be done from systematically studying the consumer use of the product and also from developments in technology, industry or the market. These ideas could be qualitatively screened so that one can see the project's aims and limitations by using a simple disciplined system of analysing the same.

The selected ideas of the technology transfer and absorption can be developed into the descriptions of the product or the target markets by the transferee. This can also be reduced in number through a complex screening method like checklist screening and economic evaluation. There can also be the formulation of technology idea concepts with the help of the consumers. Here, the idea generation stresses on the product benefits. It is when the e-consumers and company staff give their product ideas that one could boil down to a limited level of product concepts. The evaluation by the transferee will now become quantitative and will be more detailed. The same will now be based on the market research, technical evaluations and costing which will forecast if the product would face success or a failure with the company's aims.

The idea generation then is followed by screening which is continued in product design, commercialization and launch. Thus, here the product's concept could be focused, quantitative and detailed. Idea generation will thus need important skills for the person working on the product development. Thus, it can be concluded that idea generation is in relation to the inter relationships among:

$$\text{Company} \rightarrow \text{Product} \rightarrow \text{Consumer}$$

The relationship between these three parameters will be constantly changing. Also, the surrounding environment would witness social and technological change. The same will entail the understanding of the changes which will be occurring and will lead to innovative products that will fulfil a need for the transferee. Thus, the transferee will have to be aware of all these forces with their interactions before starting the technology transfer and absorption process. The same could vary from crudest level like the need for a copy of a competitor's new product (which is a 'me-too' product) to the complex technology use like pressure preservation or a major marketing change like the transformation of the multi-person to single and two-person households. There also has to be an interaction with the transferor of technology to identify and refine the technology ideas which are crucial. One could judge the need of technology transfer and absorption, like the consumer who is increasingly concerned about waste packaging.

In case of the transferee, the employees could be trained in logical and systematic thinking by the transferor of technology. It is true that a transferee has very few creative ideas related to the new technology. Product development could also be needed by the transferee; it may be required due to technological, marketing change or increased knowledge. The marketing and technical research could want modifications to existing

products from the side of the transferor. The reaction of the competitor's product would also be crucial here.

Focused or systematic thinking is generally beneficial for technology transfer and absorption. At the same time, free or the lateral thinking could be useful for major changes in technology transfer and absorption. For example, in the food industry, in which there is pressure to continuously launch the new products, the emphasis will be on systematic thinking. In case, the food companies have to bring in innovative new products, then there has to be an atmosphere that gives the freedom for idea generation.

6.6 MARKET SIZE: R&D SPEND LEVEL VIS-À-VIS GDP

Products directly based on imported technologies can have broader market base than local markets. When products are developed in-house after imbibing the technology that is comparable to international levels, the products become eligible for international markets. Also, in case of dual-use technologies, the civilian products could have a much wider market in India itself.

Sometimes, markets could start innovative approaches with different R&D groups, companies and separate individuals for varied skill sets. They use the separate internal groups or external organizations which could use the R&D skills which are crucial for the innovation and development.

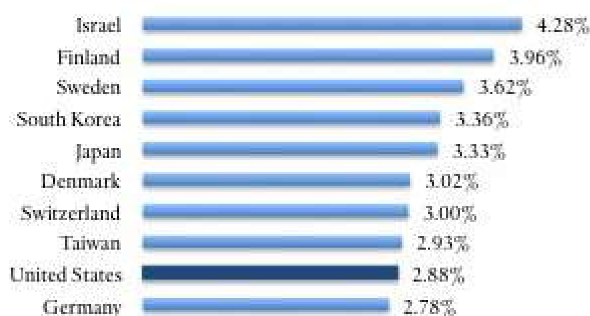


Fig 6.3: *Top Spenders on R&D as a Per centage of GDP*

Some examples of this innovative approach are as follows:

1. A research group which could gather customer insights.
2. An internal design group which formulates the concepts.
3. Developing the engineering layouts.
4. A company looking after intellectual property review.
5. Building the prototypes.
6. Formation of packaging.
7. Monitoring the supply chain management

The central idea for the R&D would be that the companies will not only be reliant on the research, but also stress on license skills, inventions, processes which come from the individuals or companies. The pace of economic and industrial progress is directly proportional to the efforts made towards the R&D that acts as a reliable

Check Your Progress

8. List the main problems organizations face while looking at fostering technology transfer and absorption.
9. What is the attitude of the technology transferee in the effective technology transfer and absorption?

measure of innovative capacity. The top spenders of R&D as a percentage of research is given in Figure 6.3. In India, R&D spend has grown to 0.9% of the country's GDP. More needs to be done to match the government's target of achieving R&D expenditure of 2% of GDP, as this will also help the nation in increasing the manufacturing base under the 'Make in India' program.

Over the last two decades, India's GDP rose to over two trillion USD, bringing millions of citizens into a new cluster called the 'emerging middle' class. The research indicates that a path driven by R&D and innovation capital could be crucial to India to grow its GDP by 9% per annum to become a 10 trillion USD economy over the next two decades. As of 2014, India's spend on R&D (0.8% of GDP) significantly lagged global counterparts such as China (1.9%), Korea (3.8%) and the US (2.7%).

It is estimated that the need for India is to increase its R&D spend to 2.4% of GDP by 2034, and focus on innovation-driven solutions to attain the growth targets mentioned above. These innovations are restricted to not only new technologies and products, but will also include designing innovative processes and business models that challenge the status quo and help achieve inclusive growth.

6.7 QUALITY OF EDUCATION AND HUMAN RESOURCES

In case, technology transfer and absorption creates a problem, the performance of the company drops. At the same time, the problem-solving mechanism will be finding out what caused the problem. The next step would be to find out the major ways to fix the problem. Here, the aim would be to get to a situation to solve the problem. For example, a production line could have an established run rate which could be 1000 items per hour. It could be possible that the run rate falls to 800 items per hour. Here, the issue would be to get the knowledge of why the same has happened. The main aim here would be to find out solutions to the problems of technology transfer and absorption. The same could be done, for example, by giving the worker a pay raise.

Here, one could be using creativity to solve a problem. The same could be done in an indirect or unconventional manner. In case, a production line produces 1000 books in an hour, and then the process of creative problem-solving will try and make the production to more books per hour. The same will be using the production line, and will try and reduce the cost of running the production line. Some of the greatest technological innovations could be seen when one is realizing an improved process which has to be implemented for the everyday tasks either. The same could be done by a proper study and documenting of the real world experience.



Lateral Thinking: It means the solving of problems by an indirect and creative approach, typically through viewing the problem in a new and unusual light.

Lateral thinking could often produce solutions in which the technology transfer and absorption problem appears as normal in the hindsight. This lateral thinking could often bring in problems which one had not known. The same might just solve simple technology transfer and absorption problems which could have a huge potential. In a production line which has produced 1000 books per hour, the lateral thinking could conclude that a reduction of output to 800 could bring in higher quality and more motivated workers.

The technology transfer and absorption puzzle will demonstrate what lateral thinking could be implemented as a process of knowledge enhancement. At the same

time, the puzzle which has a single solution is "not" lateral. At the same time, lateral thinking could help a person to construct such technology transfer and absorption puzzles. It is true that lateral thinking tools could help solve these puzzles and enhance the problem solving skills of the employees. Thus, the education and innovative knowledge imparting skills could be crucial for effective technology transfer and absorption.

In terms of human resources in a firm, the input of human resources is vital for absorbing technology. Human resources include the skills of workers on workshop, management of labour, managerial capabilities of managers and engineers (managing workers, equipment and raw materials) and the managerial ethos. If the motivation of workers and managers (the personnel) in absorbing technology is low, then it might be possible to introduce and absorb new technology easily. There are, however, no clear-cut indicators to evaluate workers' and managers' motivation to work and absorb new technology.

6.8 TAXATION AND FISCAL POLICY

Fiscal stabilization policies are crucial in promoting the R&D investments which could help dampen recessions. Companies may encounter difficulties in funds related to R&D investments as the R&D could entail a high level of risk, very high fixed costs, and returns which could materialize for a medium or long-term. The company's ability to borrow could be impaired in recessions, in case the liquidity risks are more prevalent. Thus, by reducing business cycle volatility, one could bring in a counter-cyclical fiscal policy which could make way for greater private R&D expenditures.

This could lead to a higher structural productivity growth. Also, it can be seen that differential effect could be seen to be very large which includes moving a country from the 25th per centile of the distribution of fiscal stabilization to the 75th per centile. This has increased the private R&D by 10 per cent to 16 per cent more in industries which rely on the external finance. Higher fiscal counter-cyclicality could also raise average TFP growth in these industries by 6 per cent more as per past analysis trends.

6.8.1 PPP for Technology Transfer and Absorption

Public-Private-Partnership (PPP) is also crucial for technology transfer in India. The complete transfer of authority to the private sector should not be seen as a solution to revamp the existing extension scenario.

What is needed is a blend of public and private sector which could provide success. Here, the role of public extension when it comes to globalization and privatization cannot be undermined and the same should be strengthened or else it might lead to serious damages.

The all India value of Extension Effectiveness Index stands at 47% which is moderately effective extension mechanism in India as per Mishra 1996.

Strategies for Effective PPP

The main strategies for effective public-private-partnership could be listed as:

1. Having proper linkages among the public and private extension systems.

Check Your Progress

10. List some examples of the innovative approach in R&D.
11. What role does lateral thinking play in the technology transfer and absorption problems?

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2. Implementing the same in a phased manner if the same is applicable on prioritization with the help of rational blending of public and private services which could be pro-poor and pro-women.
3. Accountability along with quality of service has to be ensured.
4. A healthy atmosphere could be created between the individuals and organizations for providing services.
5. Priority may be given for strengthening of information services to self-help groups of farmers.
6. Agricultural education could be restructured for capacity building so that it could cater to the needs of the PPP.
7. One could also promote skills based on advanced training programmes to the individuals.
8. Policy guidelines specifying the role of private and public agencies for effective the PPP.
9. Government could frame proper regulatory mechanism which could work out modalities and cost aspects and safeguard the farming community.

6.9 SUMMARY

Some of the important concepts discussed in this unit are:

- Technology absorption and technology transfer relate to existing and emerging technologies and include technology diffusion and technology cooperation with regard to equipment, know-how and software as well as their associated management systems.
- Not all companies have had the capacity to absorb and maintain the technologies they require. They facing several hurdles, especially those companies from developing countries like India.
- Information development is important for all countries, as it is the cornerstone of technology transfer. The developed countries are expected to facilitate and support human resource capacity building in developing countries.
- Businesses and groups of workers sometimes face hurdles in technology transfer and absorption. There is lack of propensity to innovate. For instance, companies in which employees are given a lot of responsibility for initiating new projects tend to be more innovative, as do companies that offer their workers a good degree of job security (which is the freedom to make mistakes and be free from the disciplinary action of the same).
- One of the special external impetuses in technology transfer and absorption has been the new knowledge, or technology. Whenever a new technology comes up, the innovative companies start exploiting the new applications and markets.
- The capability of the local industry to be able to absorb the technology could be said to be crucial when one is transferring a technology.
- Organizations that are looking at fostering technology transfer and absorption would have to wrestle with two main problems, that is, risk-taking and failure

Check Your Progress

12. What roles do fiscal stabilization policies play in R&D?
13. How is the PPP crucial for India's technology transfer?
14. List the main strategies for effective PPP in the technology transfer and absorption.

aversion. The technology transfer and absorption includes the risk and the risk brings with it the possibility of failure.

- Products directly based on imported technologies could have broader market base than local markets. When products are developed in-house after imbibing the technology that is comparable to international levels, the products become eligible for international markets.
- It is estimated that the need for India is to increase its R&D spend to 2.4% of GDP by 2034, and focus on innovation-driven solutions to attain the growth targets mentioned above. These innovations are restricted to not only new technologies and products, but will also include designing innovative processes and business models that challenge the status quo and help achieve inclusive growth.
- Public-Private-Partnership or PPP is also crucial for technology transfer in India. The complete transfer of authority to the private sector should not be seen as a solution to revamp the existing extension scenario. What is needed is a blend of public and private sector which could provide success. Here, the role of public extension when it comes to globalization and privatization cannot be undermined and the same should be strengthened or else it might lead to serious damages.

6.10 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Technology absorption and technology transfer relate to existing and emerging technologies and include technology diffusion and technology cooperation with regard to equipment, know-how and software as well as their associated management systems.
2. Businesses sometimes face hurdles in technology transfer and absorption. There is lack of propensity to innovate. For instance, companies in which employees are given a lot of responsibility for initiating new projects tend to be more innovative, as do companies that offer their workers a good degree of job security.
3. Some of the measures the company can take to enhance the easy technology transfer and absorption are:
    i. Freedom and control for task to be done when under supervision.
    ii. Independent project management, which includes the ability of the supervisor's to match the tasks of the individual.
    iii. Resources which are sufficient to realize ideas.
    iv. Given continuous encouragement, and the upper management support and the ability to take risks.
    v. The corporate climate which is compatible to making suggestions and experimenting with new things in business.
4. Idea generators could be said to be experts in a single field and could also recognize niche opportunities. These people could enjoy working alone. These people could think abstractly and conceptually.

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5. Some of the internal factors of technology transfer and absorption are:
   i. Unexpected Occurrences
   ii. Process Needs
   iii. Incongruities
   iv. Industry Changes
6. Industry changes can be listed as the internal impetus which is crucial for technology transfer and absorption. The same could bring in a rise or fall of successful innovators.
7. One of the special external impetuses in technology transfer and absorption has been new knowledge or technology. Whenever a new technology comes up, the innovative companies start exploiting the new applications and markets.
8. Organizations that are looking at fostering technology transfer and absorption would have to wrestle with two main problems. These are: risk-taking and failure aversion.
9. The attitude of the technology transferee is crucial in effective technology transfer and absorption. In a project, if the project's aims are established, then the ideas can be generated from free brainstorming.
10. Some examples of the innovative approach in R&D are:
    i. A research group which could gather customer insights
    ii. An internal design group which formulates the concepts
    iii. Developing the engineering layouts
    iv. A company looking after intellectual property review
    v. Building the prototypes
    vi. Formation of packaging
    vii. Monitoring the supply chain management
11. Lateral thinking could often produce solutions in which the technology transfer and absorption problem appears as normal in the hindsight. Lateral thinking could often bring in problems which one had not known.
12. Fiscal stabilization policies are crucial in promoting the R&D investments which could help dampen recessions. Companies may encounter difficulties in funds related to R&D investments as the R&D could entail a high level of risk, very high fixed costs, and returns which could materialize for a medium or long-term.
13. Public-Private-Partnership (PPP) is crucial for technology transfer in India. The complete transfer of authority to the private sector should not be seen as a solution to revamp the existing extension scenario.
14. The main strategies for effective PPP in the technology transfer and absorption are:
    i. Having proper linkages among the public and private extension systems.
    ii. Implementing the same in a phased manner if the same is applicable on prioritization with the help of rational blending of public and private services which could be pro-poor and pro-women.
    iii. Accountability along with quality of service has to be ensured.

iv. A healthy atmosphere could be created between the individuals and organizations for providing services.
v. Agricultural education could be restructured for capacity building so that it could cater to the needs of the PPP.
vi. One could also promote skills which based on advanced training programmes to the individuals.
vii. Policy guidelines specifying the role of private and public agencies for effective the PPP.

6.12 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Discuss in brief about the hurdles companies face while looking for enhancing their capability for technology transfer and absorption.
2. Discuss some measures which the company can take to enhance the ease of technology transfer and absorption.
3. What is significance of the diversity of personality types in technology transfer and absorption?
4. What is the role of the process needs in the technology transfer and absorption?
5. Write a short-note on the status of India in technological absorption.
7. What is the efficacy of the PPP model for technology transfer in India?

Long-Answer Questions

1. Enumerate the steps to be taken by the company to reap the benefits from technology transfer and absorption.
2. Discuss the various roles of innovation process citing some examples.
3. Describe in detail about the impact of innovative ideas on various companies while bringing in technology transfer and absorption.
4. Quality of education and human resources play vital role in fixing the problems that could arise from technology transfer. Explain how?
5. Analyze the impact of fiscal policy and taxation on the R&D.

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